The Missing Pages In This
Volume Are Advertisements

Concrete

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Another Record Year in Concrete Pavement Construction

Yardage of Concrete Pavement Placed During 1927 Exceeds That of 1926 by 12,000,000 Square Yards—Some of the Year's Developments in Design and Construction Methods—Some Thoughts on Future Developments

BREAKING records in volume of concrete pavement constructed during each succeeding year has become so consistent that the breaking of another record is not surprising. Each year since 1923 the total annual awards of concrete pavement have exceeded those of the previous year. So it was, also, in 1927. More than 126,000,000 square yards of concrete pavement—an increase of 12,000,000 square yards over 1926—were placed under contract for building new city and country traffic ways in the United States.

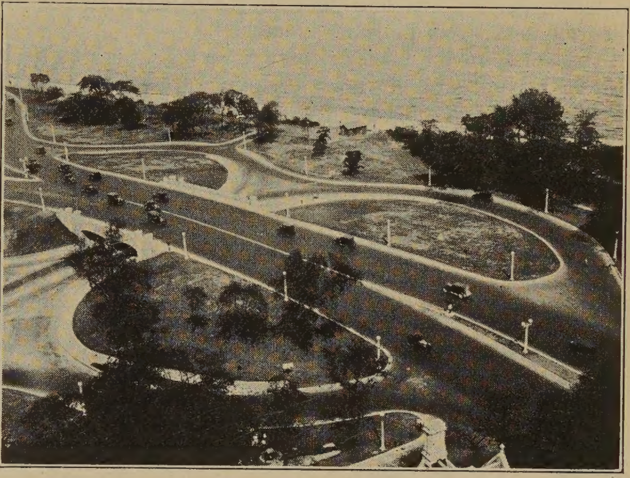
This is a definite indication of progress, but the forward strides made in quality of construction during the past year are of equal, if not of greater, importance to the industry. The past year has seen more pavements built by quality control methods than has any previous year and the experiences of engineers and contractors in this regard point to the probable developments in the future.

Concrete pavement construction has graduated from the hit-and-miss method of design and construction that were the rule not so very many years ago. Quantities of data on the relation of pavement design and of construction methods to pavement performance are now available and have made their imprint on 1927 work. Engineers are now meeting their problems in a more scientific manner and are applying in a practical way the "theories" that not long ago were looked upon as visionary and impractical under average field conditions.

Pavement Awards

Adding the 126,000,000 square yards of concrete pavement awarded in 1927 to those completed in previous years, there are now approximately 854,000,000 square yards of concrete pavement serving traffic in the United States. In terms of 18-ft. wide pavement, this would be equivalent to about 80,870 miles!

A favorable condition of the 1927 awards is that they were quite evenly distributed throughout the country. Practically every section of the United States contributed its pro rata share of the increase. The states in the west Mississippi Valley—Minnesota, North Dakota, South Dakota, Nebraska, Iowa, Kansas, Missouri, Oklahoma, Arkansas, Texas and Louisiana—have made a particularly favorable gain. These states, in the aggregate, awarded about 22,000,000 square yards.



A highway grade separation in Chicago. Highway officials have separated the grades in a number of locations where heavy traffic roads intersect. Much more of this work is planned for the future

Illinois retains its lead as the outstanding concrete road construction state. During 1927, Illinois awarded contracts for about 780 miles of highway and its 1928 program promises to set another record of volume of concrete pavement construction in a single state. Last year's awards were 3,000,000 square yards ahead of the 1926 awards.

New York follows Illinois with 650 miles of highway awards, an increase of a million square yards over 1926. Iowa jumps to third place with an equivalent of 505 miles. Sentiment for more paved road construction in Iowa indicates an unusually active year ahead in road building.

In the South, also, there was marked progress in the volume of concrete pavement awarded. Alabama jumped from 77,000 square yards in 1926 to nearly 2,000,000 square yards in 1927. South Carolina increased its awards from 493,000 to nearly 3,000,000 square yards. Arkansas, with 32,000 square yards awarded in 1926, comes forward with 550,000 square yards in 1927.

Texas tripled its concrete pavement awards while Washington and Wisconsin doubled their last year's activity.

Funds for highway construction alone provided by state and county board issues during 1927 totaled approximately $315,000,000.

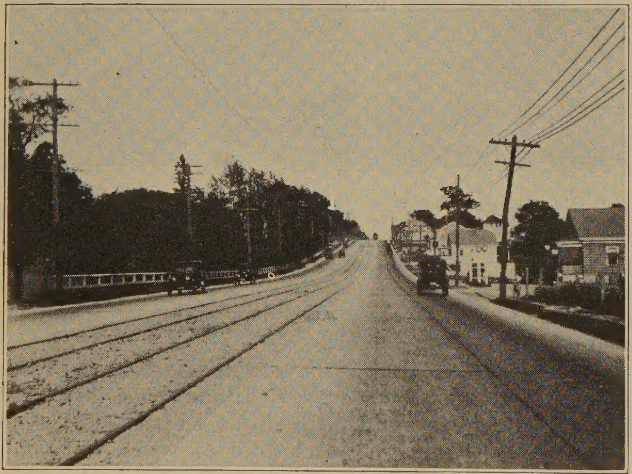
Street Awards

Approximately 47,500,000 square yards of the total awards for 126,000,000 square yards of concrete pavement were for street pavements. This, computed on a basis of streets 30 feet wide, is equivalent to about 2,700 miles of new concrete street. The 1927 awards for this purpose were about 10 per cent greater than those of 1926.

As was the case in 1926, a large portion of the awards were made in the larger cities of 100,000 population or larger. Not many years ago concrete pavements were considered fine for the small towns, but were not enthusiastically received by the officials in the larger cities. A few years ago this condition started to change. Such cities as Los Angeles, Seattle, Atlanta, Milwaukee, Chicago, Boston and others began to place concrete on their streets. At first the pavements were placed on residential streets, but gradually they extended into the business districts. Progress in enabling the officials to open the streets to traffic earlier was one point that furthered the use of concrete as a street pavement material.

Also many of the larger cities are facing a serious problem in taking care of their worn-out streets. In greater measure than ever before, these old streets are being rebuilt with concrete.

Among the larger cities that have awarded large programs for concrete street pavement during the past year are Los Angeles, Seattle, Kansas City and Chicago. Los Angeles heads the list with awards of about 3,000,000 square yards during 1927. Chicago follows with over 1,500,000 square yards. Then comes Seattle with over a million square yards. Other cities awarding substantial contracts for concrete street paving are Kansas City, Baltimore, Milwaukee, Portland, Washington, Duluth, Salt Lake City, San Diego, Tacoma, Miami and Trenton.



The New Bedford-Fall River Road, in Bristol County, Mass., is an example of the ever-growing tendency to build highways wider. Half of this road was built in 1926 *and it was completed in* 1927

Pavement Widths

There have been no radical changes in designs of concrete pavements during the past year. Most states are finding the thickened edge type of pavement very satisfactory and are using previously adopted designs of this type.

There has been a noticeable tendency to adopt 20 feet as the standard width for a two-track highway and several states have abandoned the 18-foot standard for the 20-foot standard during the past year. There seems to be a well defined trend toward the acceptance of 10 feet as the proper width for a single traffic lane and building both highway and street pavements in widths that are a multiple of 10 feet, depending on the number of traffic lanes required.

In this connection, there has been considerable activity in building 40 foot highways in various locations adjacent to the larger cities and this tendency promises increased activity this year.

Wayne County, Mich., has gone ahead with its highway widening program in an effort to realize its standard of at least a 40-foot width on its main highways. Cook County, Ill., has a comprehensive program for widening its main highways to 40 feet and one of the projects, the widening of Roosevelt Road, has been completed during the year. The Wisconsin State Highway Commission has started the work of widening one of the main east and west highways out of Milwaukee to 40 feet. In the vicinity of Buffalo a wide highway program is under way and the past year has seen the completion of a 40-foot pavement on the Mayfield road just out of Cleveland.

Slab Thickness

There is also a decided trend toward gauging the thickness of the pavement slab in accordance with the type and volume of traffic to be served. Some states have adopted several standard slab thickness designs to meet heavier traffic conditions and thus have made provisions for increasing strength through heavier construction. A number of states have increased the thickness of their standard slabs by one inch. The same is true in some cities with regard to street pavement design, the thickness and design of the pavements varying with the type of traffic they will be called upon to bear.

Several highway engineers in commenting on probable future tendencies in concrete pavement construction, anticipate that in the future engineers will specify a certain strength concrete of a definite thickness for one type of traffic and entirely different strengths and thicknesses for other traffic conditions. Naturally these strengths and thicknesses will be determined by the traffic the road is to bear and by the climate, topography and soil conditions that affect the roads.

Another question that highway builders are evidencing renewed interest in, is the matter of relation of subgrade to slab design. It is just as inconsistent, say some highway builders, to rigidly adopt a standard design for all types of subgrade as it is for all types of traffic.

Engineers are beginning to place more emphasis on subgrade studies. To secure the best results in concrete pavement construction, it is necessary to prepare the subgrade so that uniform bearing of the slab will be secured. Varying settlement of the subgrade is one of the worst enemies of concrete roads and the future will see increased efforts to eliminate this as a cause of road failure.

Joints

There are many varying opinions still clamoring for unification in the matter of placing joints in concrete pavements. The use of longitudinal joints in one form or another is almost universal in both road and street pavement construction, though the methods and materials used vary considerably. It seems that there is a trend toward the use of the dummy longitudinal joint in preference to a complete separation of the slabs where the entire pavement width is placed at a time.

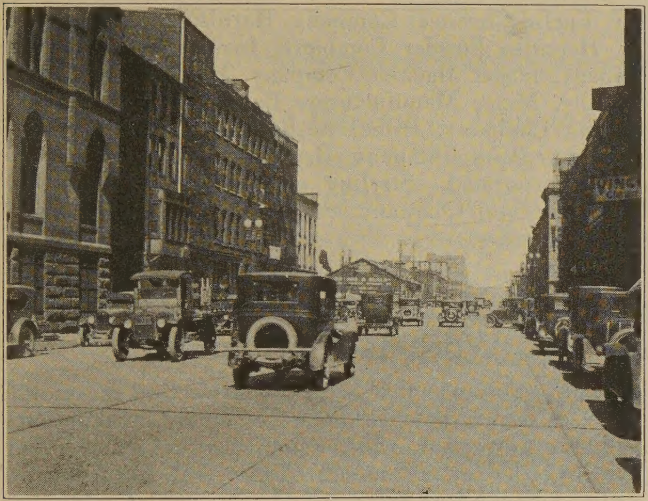
There is still considerable room for improvement in the spacing and the construction of transverse joints. Transverse joints ordinarily are difficult to construct and require considerable maintenance. The ultimate in concrete pavement design will not be attained until transverse cracks are as well controlled through proper design and proper spacing of transverse joints as longitudinal cracks are controlled through the use of the longitudinal joints.

Some highway engineers have been doing some interesting experimental work on transverse joints and the future should see definite progress made in this detail of concrete pavement construction.

Reinforcing

There is, perhaps, no detail of concrete pavement design about which there has been more speculation and on which there is greater difference of opinion than the subject of slab reinforcement. Many experimental roads have yielded helpful data on pavement reinforcing design and extensive research has been undertaken with a view to solving this question, but as yet the subject is still much disputed.

Standard specifications of state, county and city engineering departments vary over a wide range in this matter. The present tendency toward refinement in highway design, the new data available and the interchange of information on highway performance will undoubtedly yield considerable progress in this detail in the future.



Erie Boulevard, in Syracuse, N. Y., is an example of the wide pavements being placed on city streets to handle traffic. It is 57 feet wide

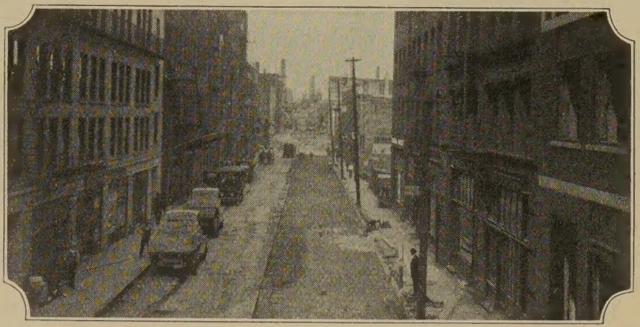
Construction Features

Several highway engineers reported that during the past year contractors have been placing concrete pavement more efficiently than before and, as a result, are getting larger production from their equipment. Greater mileages are being placed in a given time. This is largely due to improved equipment, more experienced labor and better scheduling and planning. The contractor is studying the jobs more carefully, and this, combined with longer experience, is enabling him to undertake his job more scientifically. With the present tendency toward more careful control of the concrete, the contractor must take steps to provide an organization capable of carrying out the new requirements. That means a higher type of personnel and with it comes more economical production.

The highway contractor is selecting the best possible type of equipment available. He is tending toward the use of larger pavers, the 28-E and even bigger pavers being common on most representative jobs. Preference in hauling equipment seems to be leaning toward the lighter trucks because they can get over the subgrade at almost all times with less damage to the finished grading.

Quality Control

Undoubtedly the greatest development during the past year has been the use of controlled concrete on paving jobs. A survey shows that at least 30 state highway engineers have expressed themselves as considering this the most significant development during the year.

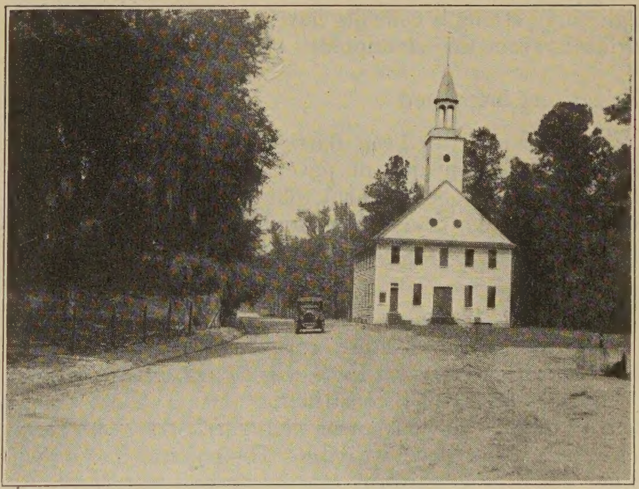


Michigan Street, Duluth, is one of the important street paving jobs of the year. It was built half at a time so that traffic would be inconvenienced as little as possible

Both in highway and in street paving operations the trend is very definitely toward specifying strength rather than proportions. A study of the various state highway specifications as revised for 1927, shows that at least 6 state highway departments definitely specify a strength of 3000 pounds per square inch at 28 days. Practically every highway department has some specifications regulating the water content, either by the slump test or by some other means.

There is also a very definite trend toward proportioning aggregates by weight instead of volume. Iowa has been doing this with outstanding success for several years and now the 1927 specifications show that six other states make provision for this method of proportioning aggregates.

Several state highway engineers are very emphatic in the statement that proportioning by weight will be the most probable new development in concrete pavement construction in the near future.



The Coastal Highway in Georgia is one of the important 1927 accomplishments. It is shown here passing the Midway Church which was built in 1778

Everywhere there is a desire to produce concrete of a more uniform quality than has been the case in the past.

Many states are now core-drilling all their finished pavements and the tests made provide valuable indications as to how to secure more uniform strengths. Road and street builders are bending every effort to attain a uniform high grade of concrete and are incorporating provisions in their specifications toward this end.

Economy Measures

During the past year there has been considerable interest in using the least expensive local materials as aggregates, provided, of course, that they are structurally sound and clean. In some locations the usual aggregates are very expensive to import and here experiments have been made with such materials as are locally available. There is a conviction in the minds of many pavement builders, that with the principles of making quality concrete now definitely established, there will be a trend toward using less expensive, locally available aggregates.

There has also been some tendency to specify the use of various sizes of coarse aggregate to be delivered to the job so that they could be scientifically combined in the proportioning plant.

Control Practice

In one state several contracts were awarded in which the stone was proportioned in three separate sizes. With this more accurate control of the materials and by careful regulation of the water-cement ratio experiments have been made with the more economical mixes. Though these provisions are still very much in the experimental state, they indicate a probable future development.

High Early Strength Concrete

For several years there has been a tendency to open pavements to traffic earlier than the old 4-week curing requirement. This has been made possible by several developments, the principal one being quality control. Where jobs had to be opened to traffic quickly, a few extra precautions in making the concrete, were necessary. A little longer mixing time, a little richer mix, the use of calcium chloride in the mix and careful curing have enabled the making of concrete that attained sufficient strength in three and four days to carry traffic safely. High early strength cements have aroused the interest of engineers from this standpoint.

Objections Removed

This tendency has been particularly marked in street paving and the opening of pavements in a week or less has removed one of the principal objections to concrete for street paving. Several outstanding jobs of this nature were completed during the past year.

1928?

What has 1928 in store for the highway builder? First, indications are that there will be reasonable activity in highway and street construction during 1928. Large sums of money for pavement construction are available and more will be made available. The country has sort of settled down to a uniform rate of expenditure for highway work and it is reasonable to expect this in the future if Congress will again grant Federal Aid equal to that granted in previous years.

There will be an ever increasing tendency toward refinement in slab design and very definite continued progress in quality control of concrete. To the pavement contractor equipped for quality production, the coming year should be viewed very hopefully.

National Construction Exposition Will Have Outdoor Exhibits

The National Construction Exposition management has announced that arrangements have been completed with the West Baden Springs Hotel, which will house the exposition, for the use of a half acre of outdoor display space for the placing and demonstration of very large and bulky construction equipment and machinery. This space is only for equipment whose operation would be impossible within the hotel. The outdoor plot is about 200 feet from the hotel, and within the landscaped grounds of the latter.

The National Construction Exposition is to be held January 23rd to 27th, at the West Baden Springs Hotel, West Baden, Indiana, in conjunction with the ninth annual convention of the Associated General Contractors of America.

Exhibitors who have already made reservations include the American Hoist and Derrick Company, American Steel and Wire Company, Atlas Lumnite Cement Company, William Bailey Company, Barber-Greene Company, Bates Valve Bag Company, Cleveland Wheelbarrow Company, Concrete Surfacing Machinery Company, Crowe Manufacturing Company, Dayton Sure Grip & Shore Company, Euclid Chemical Company, Harnischfeger Corporation, Hercules Powder Company, Insley Manufacturing Company, Jaeger Machine Company, Metal Door & Trim Company, Mixer Manufacturers Bureau, Munson Manufacturing Company, Patent Scaffolding Company, Portable Power Tool Company, H. W. Roos Company, Skilsaw, Incorporated, Sterling Wheelbarrow Company, Thomas Elevator Company, and the G. H. Williams Company.

November Construction Shows Winter Work Is Increasing

Definite assurance that winter construction is on the increase is seen in the continuance of record-breaking tactics during November, which established a volume never before equalled in that month of any year, according to statistics compiled by the Associated General Contractors of America. The amount of work handled by the construction industry during recent weeks has served to increase the leadership which the current year holds over 1926. The volume of operations recorded for the first eleven months of 1927 is five per cent greater than the figure registered for the corresponding period of last year.

These statistics, representing all types of construction, are based upon actual shipments of construction materials.

November operations were slightly smaller in volume than those of October. The fact that the decline was small is being accepted as indicating an increase in the practice of carrying on construction work despite cold weather.

December was expected to witness a scale of activities unusual for that month of the year. This expectation is based upon the fact that the volume of contracts awarded during October showed a large increase and established a record never before equalled by that month in any year. The volume of contracts awarded during the first ten months of 1927 exceeds the corresponding figure registered for 1926 by three per cent.

The average of construction costs showed a slight decline, lower prices commanded by common brick and hollow tile in several construction centers being responsible. The average of wages remained unchanged during November, this being the tenth successive month to see this situation prevail.

The new Ford bridge over the Mississippi River is one of the important structures built during 1927. There are three 300-ft. arches. The bridge contains 40,000 cubic yards of concrete

What Happened in Structural Concrete in 1927

A Review of Developments in the Field of Reinforced Concrete During the Past Year—Increase in Use of Quality Controlled Concrete Is Outstanding—Light-Weight Aggregates Come into More General Use—Building Code Improvements—Some Outstanding Structures Completed During 1927—Bridge Construction—Volume of Construction

1927 HAS contributed its fair quota toward progress in the structural uses of concrete. With a material that, in the short space of a quarter of a century, has risen from obscurity to a point where it is now used in approximately 10,000 structures annually, each year cannot help but show some very definite points of progress.

Progress is not merely a gain in the number of cubic yards of concrete placed. In fact, the past year has not seen such a great increase in the volume used. The greatest progress has been in the application of our increasing knowledge of how to use this material with greater assurance as to the resulting quality of the concrete. This past year, more than ever before, actual field practice has seen the effect of research in concrete. What only a short time ago was considered "theory" has now become standard practice on representative jobs.

Nor has the past year been entirely free from negative influences. Other building material interests have recently launched aggressive campaigns for forwarding their interests and as a result, reinforced concrete has come in for more criticism than has been its lot for many years.

These tendencies have brought the question of the selection of building materials to the fore, and by so doing, have helped to spread the story of reinforced concrete. They have caused engineers to concentrate on some of the disputed points regarding the performance of reinforced concrete structures and thus have brought about a better understanding of these points.

Quality Control

The progress in the use of the water-cement ratio method in controlling the strength of concrete has been so marked that the adoption of this method on individual projects is no longer a novelty. It may be said, in fact, that a large construction project on which attention is not given to the water-cement ratio and the more careful proportioning of aggregates is now the exception instead of the rule.

Railway engineering departments and the construction departments of municipalities and of public utilities continue to lead the way in the practical application of the water-cement ratio method. National organizations that have adopted the water-cement ratio method in standard specifications for concrete work include the American Railway Engineering Association and the American Petroleum Institute.

The highway commissions of seven states likewise have written this method into their specifications for all concrete work on bridges and highways. The building codes of at least nine cities have incorporated the water-cement ratio method in the regulations governing reinforced concrete work and to a large degree permit the working stresses in concrete to be based on the strength attained.

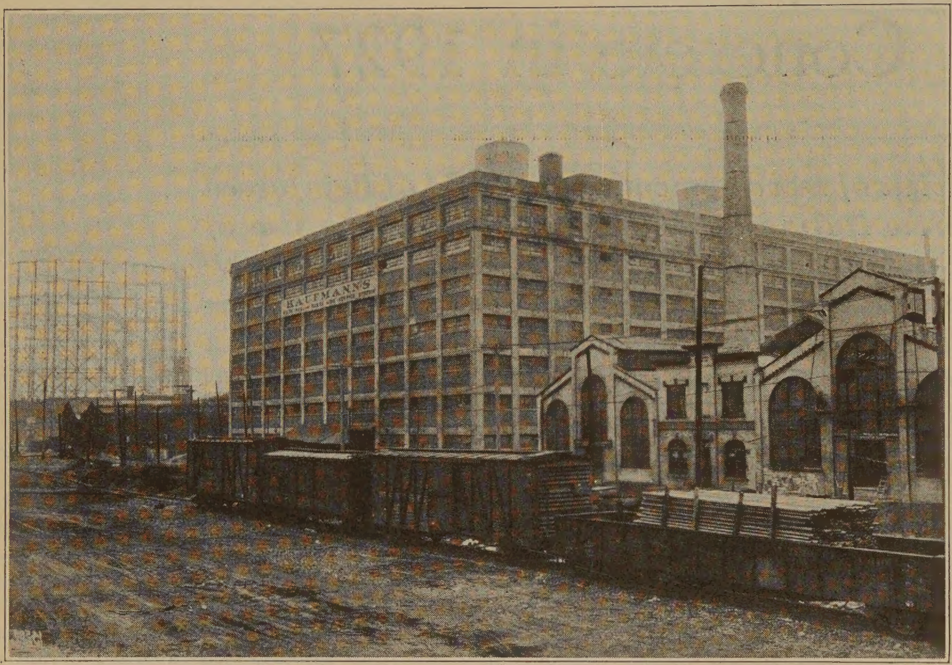
In addition, some thirty cities, many of them of large size, have specified the water-cement ratio method on municipal work.

In addition, notable progress has been made in guaranteeing the proper placing of concrete by more care in handling reinforcement. Specified clearances and dimensions are more carefully lived up to now than at any previous time.

In the meantime the Portland Cement Association has continued its short courses of instruction with no sign of abatement in interest.

Light-Weight Aggregates

Concrete aggregates of light weight have received increasing attention during 1927. One well-known product manufactured of burned shale or clay and used for both fine and coarse aggregates has been placed on the market by one of the largest clay brick manufacturers of the Middle West. The material has been used in a considerable number of reinforced concrete buildings and concrete-encased steel buildings in Kansas City and Chicago, as well as in the floors of steel bridges. This material produces concrete weighing around 95 pounds a cubic foot, with a strength approximately that of stone or gravel concrete.



Late in 1927 the gas tanks in the left background of the illustration exploded. The reinforced concrete warehouse shown suffered no damage except that the window panes were blown out

Greater use of light-weight aggregates in structural concrete can reasonably be expected in the very near future.

Research

Research work is continuing in many directions, both with respect to portland cement itself and to its uses in concrete.

The research work on the constitution of portland cement, now under way by the Portland Cement Association Fellowship at the U. S. Bureau of Standards, is making headway. Papers No. 3 and No. 9 regarding this investigation were published during the year in this journal. Other researches in cement deal with the subjects of volume changes and fluid cement-water mixtures.

Studies of the aggregates include investigations on the effect of aggregate grading on strength of concrete, efforts to develop methods for determining the durability and soundness of aggregates and other subjects.

Concrete investigations include the study of admixtures, coloring materials, curing methods, effect of exposure to alkali, sea water and low temperatures, etc.

Much additional data that will be of value to concretors is being developed in these researches. The progress in quality control, so generally used during the past year, is the result of the application of the facts learned during previous studies and researches.

Cement Quality

The subject of quality of cement has been of very great interest to concretors during the past year. A greater number of cement manufacturers have put special cements on the market and are selling them as particularly advantageous for securing high early strength or for assuring greater resistance to deterioration under special exposed conditions.

The result of placing these cements on the market has been that the contractor is giving more attention to cement quality than before. The attacks on concrete, mentioned before, have also drawn attention to the part played by the cement itself in the durability and performance of concrete structures especially under exposed conditions.

Tall Buildings

The year has seen serious consideration given to the projection of buildings to great heights not previously considered economically feasible. In contrast to this development there has been considerable crystallization of sentiment against the building of unlimited height, not because of economic considerations as affecting individual buildings, but because of difficulties with respect to traffic congestion, light and ventilation. Even in our greatest cities only a small proportion of the buildings in the downtown sections now extend to great heights; but every large city is now wrestling with traffic congestion against almost hopeless odds. If nearly all buildings in those sections are built to great heights the congestion of foot and street traffic may well become intolerable.

The Master Printers Building, in Tenth Avenue between Thirty-third and Thirty-fourth Streets, in New York City, has set a new height record for buildings of reinforced concrete frame construction in the United States. It is 20 stories or 310 feet high, measured from the sidewalk level, and exceeds by about 34 feet the height of the United Brethren Building in Dayton, Ohio, a 21-story reinforced concrete building which held the height record for several years. The year just closed has also seen the completion of the Hotel Palacio Salvo, at Montevideo, Uruguay, a reinforced concrete building 28 stories or 338 feet high above the sidewalk level. This is the tallest building in South America and the tallest reinforced concrete building in the world. Other reinforced concrete buildings of greater height are contemplated.

Concrete in Architecture

There has been a definite tendency toward the use of concrete as an *architectural* material as well as a *structural* material. The past year has seen the use of concrete both as the structural and the ornamental material on a number of important projects. One of these, the Pasadena City Hall, is described in this issue.

During the year there has been published a book dealing exclusively with concrete in architecture, a review of which will be found on another page of this issue. The fact that such a book has been published especially for the architect is an indication of the progress being made in this newer use of concrete.

Researches

There has also been a great deal of interest in the subject of color in concrete and important researches in this subject are now under way. The increasing use of integral and surface color treatments of concrete is an indication of the possibilities for future development of the applications of concrete as an architectural material.

A type of the "set back" architecture, now so common in our larger cities. The structure is one of a group of buildings completed the past year near the New York entrance to the Holland Tunnels

A new form of design has come to the front more emphatically during the past year, called "composite design." In this type of construction the framing for the lower floors (or at least the columns) is built of structural steel, while the greater portion of the building, including the upper floors, is built of reinforced concrete.

The Lee Plaza, Detroit, a 17-story reinforced concrete structure built during 1927. It is of unusual design, illustrating the use of reinforced concrete in an irregular plan without interfering with the architectural features of the building

Building Codes

Progress in the development of uniform building codes and revision of existing city building codes has gone forward in a satisfactory manner. The Pacific Coast Building Officials' Conference adopted the final draft of its proposed uniform code at its sixth annual meeting in October, and the book is expected to be in print before the end of January, 1928. A continuing organization was formed to revise the draft from year to year. The Florida Building Officials' Conference, using the preliminary draft of the Pacific Coast code as its guide, now has its first draft in mimeographed form and the code committee is considering and compiling criticisms received and changes to be made. The codes developed in this manner by the Pacific coast and the Florida organizations have a double value to the building industry. In the first place, they are not revisions of existing codes, but are entirely new documents, and the requirements are in line with modern knowledge of building materials and methods of construction. Another advantage is that of uniformity.

Revisions

The building codes of many individual cities were revised during the year. Among the most notable of these is the code of Chicago, which is undergoing general revision. While the work is far from being completed, substantial progress has been made. An interesting development during the year was the new California law known as Senate Bill No. 247, which permits cities to adopt building codes and plumbing and electric wiring ordinances by reference, thereby saving the cost of legal advertising and publication in book form. This law is of particular value to the smaller municipalities.

Another evidence of co-operation in preparing building codes is found in the new "Standard Building Regulations for Reinforced Concrete" which is now recommended by Committee E-1 of the American Concrete Institute and the Committee on Engineering Practice of the Concrete Reinforcing Steel Institute. This is the first time that these two entirely different schools of thought have been able to meet on middle ground.

Bridge Construction

Bridge construction during 1927 has included a number of large and attractive structures of the reinforced concrete multiple arch type, but none of outstanding size. Among the most attractive bridge structures completed during the year is the Ford Bridge across the Mississippi River at Minneapolis, built at a contract price of $1,324,000, and involving the use of 40,000 cu. yds. of concrete. This bridge has three principal arch spans each 300 feet in the clear, and one shorter arch span and several approach spans at each end. The total length is 1,522 feet.

One of the largest municipal projects completed during the year is the double deck street known as Wacker Drive, along the south bank of the main branch of the Chicago River. The structure was completed early in the year, after two years of work. It involved the placing of 120,000 cu. yds. of heavily reinforced concrete. The structure carries boulevard traffic on the upper deck and truck traffic on the lower. Great office buildings are springing up rapidly along this development on locations formerly occupied by very old buildings of ordinary construction, used until recently by the merchants of the South Water Street provision market. In the transformation South Water Street has disappeared and the former market of that name has been moved to a great reinforced concrete structure on the west side.

Other Uses

The great Santeetlah dam near Calderwood, Tenn., belonging to the Tallassee Power Co., on which work was started in the latter part of 1926, has been going forward at a satisfactory rate of progress. All the concrete work is put in under the water-cement ratio method of control. Excellent progress has also been made by the Engineering Foundation of New York in its tests on the Stevenson Creek experimental dam near Fresno, Calif. This structure is a concrete dam of arch type, 60 feet high, and was built for the purpose of testing it to destruction. In the meantime the investigators are obtaining all possible information regarding the stresses developed. These tests have not as yet been completed, but will be reported in due time.

Demand for Stadiums

The construction of athletic stadiums for universities, colleges, high schools and municipalities continues without abatement. It is said that the total attendance at football games during the 1927 playing season exceeded all previous records, indicating that popular interest in that game is still on the upgrade.

Lessons Learned from Disasters

Among the great calamities of the year from which structural lessons may be learned the outstanding ones are the Mississippi Valley and the New England floods, the St. Louis tornado and the Pittsburgh gas tank explosion.

The floods in the Mississippi Valley, which were under way at the beginning of April, continued for many weeks and proved that present flood protection works are inadequate. The unusual situation arose from the fact that all the tributaries of the Mississippi were flooded at the same time. Inasmuch as virtually all structural damage was caused by submerging or undermining, few structural lessons could be drawn either from the Mississippi Valley floods or those in New England in November. The St. Louis tornado, on the other hand, which was fully reported in the November issue of this magazine, proved conclusively that ordinary walls of solid brick masonry, built in the ordinary way, offer little security in an emergency of that nature. This tornado has added to the lessons taught by other violent storms of recent years, namely, that the masonry wall must in some manner be reinforced if it is to offer the necessary security. An illustrated article in the December issue of this magazine describes one method of reinforcement.

The tank explosion at Pittsburgh, on November 14, caused great destruction in all directions, many buildings having been ruined and others badly damaged. Within the area devastated by the explosion were three modern reinforced concrete buildings of the industrial type. None of them suffered structural damage, although most of the window glass in them was broken. The three buildings were the Kaufmann Warehouse, seven stories high, the Standard Sanitary Co. Building, six stories high, and the two-story office building of Asphalt Plant No. 2 of the City of Pittsburgh. In this explosion reinforced concrete construction has again demonstrated its ability to resist forces of great and unusual intensity.

Volume of Construction

During 1927 the construction industry has seen a definite reduction in new construction of buildings for which city building inspection departments issue permits; but the increase in other construction work has more than offset the loss in building permit values. This increase in other construction work is due in considerable measure to the increase in volume of new construction coming under the classification of public works and public utilities.

Permit values in 210 cities for the first ten months of 1927 were $2,829,000,000, a decrease of 12 per cent from the first ten months of 1926, when the amount was $3,213,000,000. On the other hand, all construction work reported by the F. W. Dodge Corporation for the first ten months of 1927 amounted to $5,359,000,000, a small increase over the same period for 1926, when the amount was $5,325,000,000. The same reports give a figure of $1,095,000,000 as the total of contracts awarded in the field of public works and public utilities, compared with $937,000,000 for the first ten months of 1926.

While the increase in all construction work has more than offset the reduction in building construction so far as value is concerned, the fact remains that reduction in building construction has caused a corresponding reduction in the demand for accessories entering into buildings, for which there is no offset. The decrease in building permit values can best be visualized from the figures reported for the first ten months of 1927 and the corresponding period of 1926, in five of the largest and most rapidly growing cities. The comparison is shown in the following tabulation.

Permit Values First 10 Months of Year

	1926	1927
New York City	$865,000,000	$740,000,000
Philadelphia	110,000,000	104,000,000
Detroit	156,000,000	123,000,000
Chicago	314,000,000	302,000,000
Los Angeles (to Nov. 15)	109,000,000	113,000,000
Totals	$1,554,000,000	$1,382,000,000

Los Angeles is consequently the only one of the five cities mentioned to show an increase.

Cashing in On
A Longer Road Construction Season

How an Ohio Concrete Road Contractor Started a Road Job at a Time When Many Contractors Are Preparing to Shut Down for the Winter—Time-Saving Methods Permitted Him to Complete Half of the Job at the Tail End of the Season

By H. D. CHAPMAN
Engineer Inspector, Department of Highways and Public Works, State of Ohio

ON September 17, 1927, the Dunzweiler Construction Company of Zanesville, Ohio, were awarded the contract for the construction of a 6.8-mile concrete road job on I. C. H. No. 348, a main traffic highway in Muskingum County, Ohio. Though the construction season was pretty well advanced, and many other contractors were preparing to shut down for the winter, the Dunzweiler Construction Co. began organizing the job immediately, and by adopting various time-saving methods, were able to complete 3 miles of pavement before actually closing down for the season.

No records were broken insofar as speed of construction was concerned, yet considering the lateness of the season and the quality of the concrete secured, the difficult location, etc., this project can be considered one of the outstanding concrete pavement jobs undertaken in Ohio during the 1927 season.

The topography along the location of the new road is somewhat rough and, while it cannot be characterized as mountainous, it is such that there are many curves and grades. The maximum grade on the project is 8.5 per cent for a distance of 1400 feet. Grades of over 5 per cent are encountered in several other places. Of the total length of contract, 2.1 miles are on curves.

The design used was the standard 18-foot concrete pavement, 7 inches thick at the center and 9 inches at the edges, with a steel center joint and edge bars. The roadway was graded under a former contract, so that the present contract required only the fine grading.

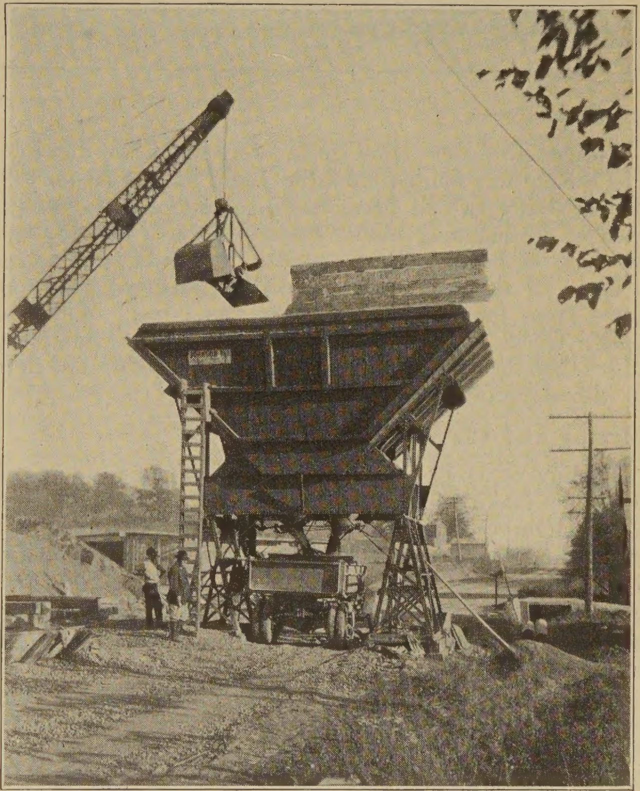
Unloading and Batching

Washed gravel was used as the coarse aggregate. The materials were transferred from the cars to the batcher by means of an Orton crane. This piece of equipment gave very satisfactory service and no delays were suffered on account of breakdowns. Any excess material was stockpiled, but due to careful work on the part of the contractors in ordering materials and following up shipments, very little of the material was rehandled. A Johnson batching plant was set up, spanning the roadway. This was made possible by the proximity of the railroad to the highway and by the fact that the highway was closed to traffic during construction.

Subgrade Prepared at Night

One of the unusual features of this contract and one that speeded up the work, was the method of preparing subgrade. This work was done at night by an extra shift of men. A portable Delco lighting plant equipped with a powerful searchlight was used.

A force of about 20 men started work on the subgrade as soon as the mixer shut down in the evening. This enabled them to carry on the work without being interrupted by the trucks. A definite amount of work for the next day's run was laid out in preparing the subgrade and setting the side forms. As soon as this was done the men were released. The work was generally completed between midnight and 2 A. M.



The crane transferring material from the car to the bins. The proportioning plant is located directly over the subgrade of the new road

No difficulties were encountered due to inaccurate work and the form setting and operation of the subgrade machine could be carried on without interruption due to hauling. This method, considered with reference to the general progress, was found to be more economical than doing it during the day.

Preparation of the subgrade at night under electric light enabled the laborers to work continuously without being interrupted by trucks. This speeded up the work

Hauling

Eleven two-batch Hug trucks were used on the job. The cement was hauled from the plant. It was frequently delivered hot, which necessitated maintaining a storage shed at the batching plant. No cement at a temperature in excess of 140 deg. F. was used in the concrete.

Eight of the trucks were used in transporting aggregates from the batching plant to the mixer. With the lighter trucks and the pneumatic tires used, the subgrade, which had been prepared the preceding night, was left in almost perfect condition.

Mixing and Placing

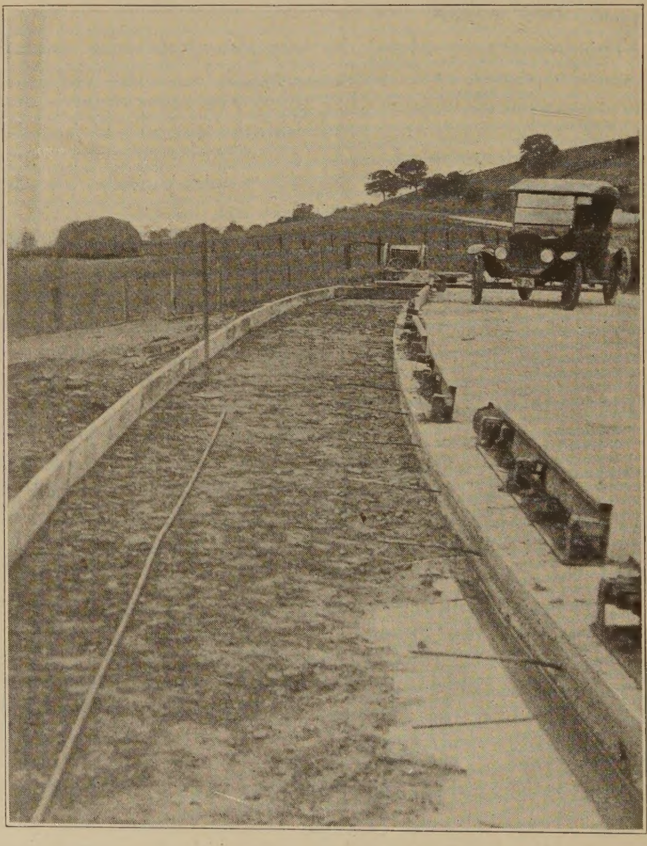
Placing concrete began October 6th. The proportions were 1:5, making allowance for the bulking of sand, with a minimum cement content of 6.7 bags of cement per cubic yard of concrete. The mixing time requirement was 1¼ minutes. A Koehring 27-E mixer was used which gave a uniform, well mixed product. Due to the steep grades it was necessary to pour the concrete at a slump of about one inch.

The Ord finisher used on the job handled the dry concrete in a satisfactory manner. Very few honeycombed or irregular spots were left after the finishing machine had passed over the concrete the second time. By careful form setting and operation of the finishing machine, it was possible to eliminate practically all hand finishing. No hand floating was done unless absolutely necessary. The surface was straight-edged about 40 or 50 feet back of the finishing machine but the care taken in the previous operations made the straight-edging rather monotonous—very few irregularities were found.

The average daily output was about 700 feet. The largest day was 857 feet.

Placing Concrete on Curves

The method adopted for placing concrete on curves contributed very materially in maintaining the large daily output. In finishing curves, the finishing machine was run around the inside 18 feet of the pavement. The forms, set to accommodate the finisher, were graded to conform



In placing concrete at curves, the outside form was first set 18 feet from the inside form so that the finishing machine could operate without interruption. The widened part of the curve was concreted later p 25-4 [illegible] - OK

EDITORIALS

By Our Works They Shall Know Us

NO other one thing stands out with such striking uniformity in the activities of all branches of the concrete industry during the past year as the growing tendency toward the making of quality controlled concrete. In the structural field, the highway field and the products field, the practical use under job conditions of common-sense proportioning and accurate control of water content sound an unmistakable note of definite progress.

And the tendencies of the past year point the way toward future greater progress. Here is the line along which every concretor, regardless of his station or place in the industry, can influence the future progress of the industry and so determine his own fortunes.

There are several logical reasons why it is to the interest of every concretor to get back of the movement to make better concrete. Some of these reasons affect the personal prosperity of the individual. All of them affect the progress of the industry as a whole.

In the first place, there is no longer any reason why any concretor should be unable to control the quality of the concrete he places more accurately. Contractors and engineers everywhere have demonstrated the fact that the principles involved can be applied in a practical, common-sense manner to most any type of job whether in the field or in the plant.

Equipment manufacturers have come forward with devices and methods that automatically take care of the requirements for making better concrete. The equipment is simple and easily operated and an exhaustive technical knowledge of the theories is not necessary. Furthermore, a wealth of information on the easily understood precautions to be observed has been given out from a number of sources. The simple requirements, stated in plain, non-technical language are available as well as detailed reports of especial interest to the technical man.

Naturally, the first consideration is, "How does this affect me, personally? Does it show me a way of bettering my business?"

Decidedly, it does. There are hundreds of instances where concretors have made remarkable savings in the cost of materials by better proportioning and by regulating the amount of mixing water used. Contractors have cut down the cost of the materials needed as much as 80 cents for each cubic yard of concrete.

To a greater extent than ever before, the individual contractor is placed in competition with other contractors who have learned to take advantage of this method of reducing costs. More than that, the concretor who is placing quality controlled concrete is building an enviable reputation which stands him in good stead.

The same condition exists in the products industry. The products manufacturer who can turn out a block of guaranteed quality at a lower cost than his competitor has an obvious advantage.

Much has been said recently about the new competition—the competition of industry against industry. Taken in its broader sense, one concretor does not compete with another concretor. They both have a common competitor—the man who works with other building materials than concrete.

The concrete industry has long been organized and has for many years spread the facts about the advantages of concrete as a building material. For a long time we had the drop on the other fellows.

Recently, however, other building material interests organized and they have become very active during the past year in promoting their materials. The concretor began to notice that the new competition affected him also.

Recently, also, concrete as a building material has been under fire in some quarters. Its alleged faults and imperfections have been made much of. Whether or not these accusations are founded on fact, they have been of value to the industry in stimulating progress in research and in improving the rank and file of the concrete placed in our structures. This has had a beneficial effect on the quality of concrete that will be placed in the future and will indirectly operate to the benefit of every concretor.

Clearly, the keynote for the coming year must be the placing of more quality controlled concrete. The efforts of everyone in the industry should, therefore, be concentrated on this important possibility for even greater progress in the year ahead.

The Effect of Sugar Upon the Tensile Strength of Portland Cement Mortar

Tests Show That When Small Amounts of Sugar Are Present, Strength Decreases Rapidly, but That Larger Amounts Do Not Reduce Strengths as Much

By R. L. MORRISON and E. A. BOYD
of the Michigan State Highway Laboratory

OCCASIONALLY a sample of sand will be received at a laboratory and will pass all tests satisfactorily, including the sodium hydroxide test for organic impurities, except that it will be almost impossible to make briquettes for tensile tests and, if the briquettes can be made, the strength will be very low. Investigation in such cases will usually show that the sample was shipped in a sugar sack.

After an instance of this kind in the Michigan State Highway Laboratory some experiments were made to determine the exact effect of varying amounts of sugar, and this investigation developed some rather interesting information.

A sample of clean sand was first taken and tested in comparison with standard Ottawa sand, the results being:

Standard sand	7 days, 255 lb.,	28 days, 357 lb.
Sample sand	7 days, 373 lb.,	28 days, 490 lb.
Strength ratio	7 days, 1.46,	28 days, 1.37.

A supposedly empty sugar sack was obtained from a grocery store and some of the sample sand was placed in the sack, dry, and well shaken. Briquettes were then made with the sand but they crumbled so that they could not be tested. The experiment was repeated with another sack except that the sand was wet before it was placed in the sack and the strength of the briquettes made from this was 248 pounds at 7 days and 403 pounds at 28 days, giving strength ratios with the standard Ottawa sand of 0.97 and 1.12, respectively.

Scope of Tests

The above tests proved that a small amount of sugar in the sand would greatly reduce the tensile strength of the cement mortar, but there was no information as to the exact amount of sugar present. To determine the effect of varying amounts of sugar, a series of tests was made, using a 1:3 mortar and curing the briquettes in the usual manner, keeping them 24 hours in a moist closet and then placing them in water. As the water seemed to be especially destructive to these briquettes, a second series of tests was made in which the briquettes were kept in the moist closet during the entire curing period. The results of the above test are shown in Table I.

The striking feature of these results is that when small quantities of sugar are added to sand the strength decreases with increasing amounts of sugar up to about 0.3 to 0.4 per cent, by weight, of sugar to sand, but when further additions of sugar are made, the strength rises again, reaching a second maximum at about eight or nine per cent. In one case, although 0.2 per cent of sugar caused the briquettes to disintegrate to such an extent that they could not be tested, ten times that amount produced briquettes which could be tested, and 45 times as much gave a tensile strength of 162 pounds per square inch.

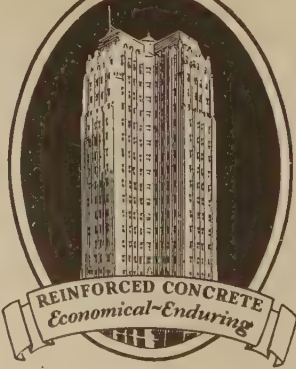
The tests demonstrate clearly that sand samples should never be shipped in sugar sacks.

TABLE I

Effect of Sugar Upon Tensile Strength of Cement

	7 Day Tensile Strength		28 Day Tensile Strength	
Per Cent Sugar to Sand	Cured in Water	Cured in Moist Air	Cured in Water	Cured in Moist Air
0.00	417	388	472	518
0.02	338	382	475	487
0.04	242	327	478	480
0.06	100	230	408	335
0.20	*	40	35	90
0.40	*	50	*	63
0.60	*	35	*	75
1.00	*	57	*	140
2.00	40	118	53	152
2.20	70	105	70	168
2.40	70	115	70	183
2.50	30	105	68	193
3.00	63	103	92	193
3.50	90	140	113	198
4.00	123	***	135	***
6.00	148	***	160	***
7.00	148	***	172	***
8.00	150	***	183	***
9.00	162	***	178	***
15.00	78	147	**	178
20.00	**	97	**	110
25.00	**	*	**	*

*Briquettes disintegrated in storage.
**Did not set up in 24 hours in moist closet.
***No briquettes made.



Institute Adopts New Emblem

The accompanying illustration shows the new emblem adopted by the Concrete Reinforcing Steel Institute.

It is becoming widely used on building signs where steel is supplied by member firms for reinforced concrete construction.

Completed and Occupied A Floor a Month *During Winter*

A Philadelphia Contractor Proves That Winter Construction Is Practical

THE general contract for the Heid Loft Building at 13th and Wood Streets in Philadelphia was awarded on October 15, 1926. The owners moved in June 15, 1927.

The 8-story reinforced concrete building was completed and occupied 8 months after the general contract was awarded. Three of these months were months that the old-fashioned contractor would not count on his working calendar—December, January and February.

This record of accomplishment is an excellent example of what can be accomplished by up-to-date winter construction methods. The building is 71 feet by 144 feet in plan and contains 10,300 square feet of floor area per floor.

There were the usual preliminaries of wrecking the old two and three story brick buildings and excavation was started November 10th. This part of the work, although it contains no particularly unusual features, was long and tedious because of the amount of shoring and underpinning necessary to support the adjacent building. One section of the old party wall was condemned and had to be replaced.

The concrete footings were all poured by December 24th. The interior footings are of the ordinary spread footing type, designed for a soil pressure of 8,000 pounds per square foot. The exterior footings are combined footings that cantilever back to the first row of interior column footings.

The floors are designed to carry a live load of 150 pounds per square foot and have a monolithic finish. The typical flat slab panels are 22 feet by 23 feet, using the Smulski system of reinforcing. The columns are all reinforced concrete, spiral reinforcement being used in the lower floors. The maximum size column is thirty-eight inches and on the lower floors a 1:1½:3 mix was used.

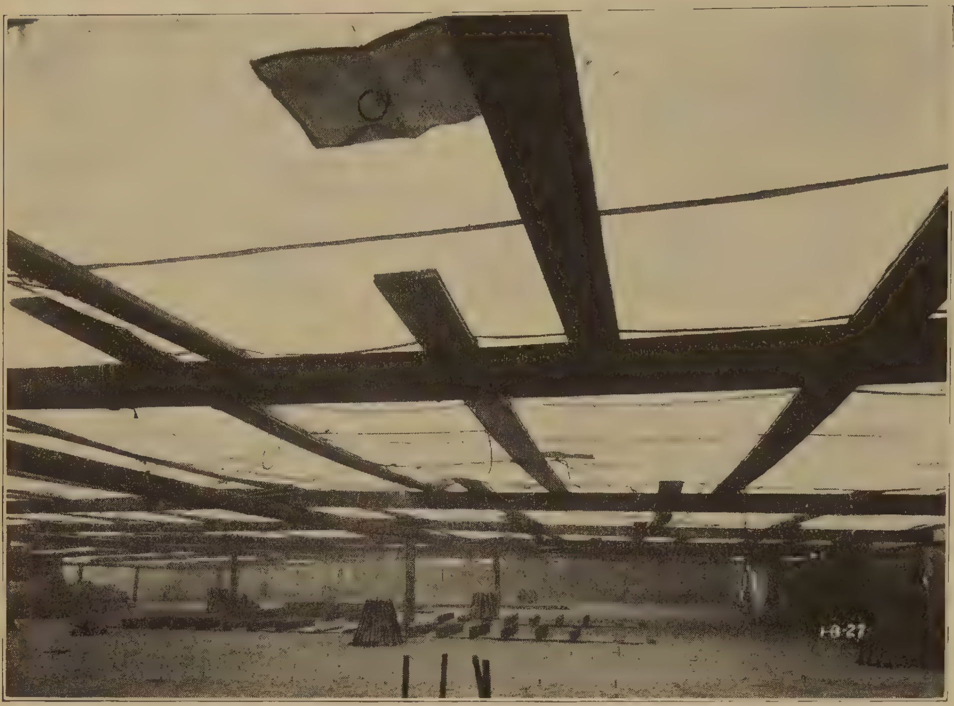
The concrete schedule for the super-structure was as follows:

First floor slab placed January 6th.
Second floor slab placed January 22nd.
Third floor slab placed February 5th.
Fourth floor slab placed February 11th.
Fifth floor slab placed February 18th.
Sixth floor slab placed March 1st.
Seventh floor slab placed March 10th.
Eighth floor slab placed March 18th.
Roof slab placed March 26th.

This progress schedule is particularly noteworthy when we realize that due to the monolithic finish, the floors had to be protected for several days with sawdust before they could be gotten on to erect the forms for the floor above.

In addition to this, the pouring was done in mid-winter.

Showing the canvas in place for winter construction. Practically all the concrete was placed during the winter months



An interior view of the canvas protection. Six feet of clear headroom was maintained under the canvas to permit working without interference

The temperature was maintained at 40 degrees Fahrenheit above the slab and 70 degrees Fahrenheit below the slab during the curing period, which lasted five days. At times the outside temperature was down to 7 degrees Fahrenheit. Heat holes, 8 by 8 inches in size, were left in the center of each bay. One charcoal salamander was used per bay except on the windward side of the building where extra salamanders were used to maintain the desired temperatures.

The contractor used 25,000 square feet of canvas on the job. This canvas was in pieces about 24 feet by 24 feet, supported with 4 by 4 inch timbers, located adjacent to the concrete columns as shown in one of the illustrations. The stringers for supporting the canvas were 2 by 8 inches. Six feet of clear head room was maintained under the stringers for the workmen. There were five tying rings in each section of canvas; one located in the center and the others at the four corners.

The building as it appeared April 2, 1927

The completed building showing the exposed spandrels and exterior columns

The concrete, when placed, was maintained at a temperature of about 76 degrees Fahrenheit. The mixing water was heated with a low pressure boiler, which saved the expense of a licensed engineer, to a temperature that was always above 150 degrees Fahrenheit and sometimes near boiling point. The aggregates were heated by steam which ran through 4- by 4-inch perforated boxes about 30 feet long in the stockpiles. There were three or four of these perforated boxes under each pile. The contractor found these perforated boxes preferable to perforated pipe for heating concrete aggregates because of their greater area and efficiency. The aggregates went to the mixer at a temperature of about 70 degrees.

Stuckert & Company, of Philadelphia, were the architects and engineers. The Smulski system of reinforcing was designed by W. R. Sauter. The J. B. Rogers Company were the general contractors.

"A Profit in 14-Cent Block!"

Some Additional Operating Data on the Production of Concrete Block at the Plant of the Hammond Concrete Block Works, Hammond, Ind.

By **JAKE GOLDEN**
Hammond Concrete Block Works, Hammond, Ind.

AN article published under the above title in the November issue of "Concrete" has caused considerable discussion. A number of letters have been received, requesting additional information regarding the methods that enable six men to turn out 3200 plain 8- by 8- by 16-inch block in a 9-hour day.

THE first article describing this plant, published in the November issue, should be read as a background for this discussion.

AFTER the letters referred to were received, the questions asked were submitted to Mr. Golden and he has prepared this article to supply the additional information requested.

INCIDENTALLY, Mr. Golden invites anyone interested to visit his plant in the spring, when it will again be in operation. At this time he will be glad to demonstrate his statements. He is very confident of his position and is willing to back up his statements with anyone who cares to discuss the matter more intimately.—*The Editors.*

SOME time ago I gave the editors of this journal certain data concerning the operation and design of my block plant at Hammond, Ind. From these data a story was prepared and published in the November issue under the title, "A Profit in 14-Cent Block!"

I am glad to have the opportunity of again making some of the statements and to go into greater detail on some of the disputed points. The statements made in the article referred to are substantially correct and I am willing to demonstrate them to anyone interested when my plant will again be in operation in the spring.

Six Men Can Make 3200 Plain Block Per Day

There seems to have been some doubt that six men can make 3200 plain 8- by 8- by 16-inch block per day. In the first place, it is necessary to say that this is not given as a steady day-after-day production. Such a rate of manufacture would be unwise for two reasons—first, there is not yet a market for so many block in this territory; second, it is seldom that all three machines are used all day for making 8- by 8- by 16-inch plain block. Depending on the market requirements, one and sometimes two machines are used for making the various face blocks or tile demanded by my buyers. Also, sometimes men are taken from the power machines and put to making chimney block and other specials.

The statement that 6 men could turn out 3200 8- by 8- by 16-inch face block per 9-hour day was based on maximum production for a day during which all the machines make plain block throughout the day.

Production Statistics

As mentioned in the previous article, there are three power block machines in the plant, a Universal down face machine, a Universal stripper and a Blystone automatic. Production records taken from our books show the following facts:

1. *Universal Down Face Machine.* Even when the machine operator moves the loaded racks away from the machine to the end of the building, he has made, according to our records, 750 plain blocks in 9 hours. This production was made even though a half hour was allowed in the morning for oiling and greasing the machine and a similar period for cleaning up in the evening. Under the new plan of operation, the machine operator will not be required to touch the racks and will thus be allowed more time actually at the machine.

2. *Universal Stripper.* When the operator moves his own racks, our records show that he has made 1022 blocks in a 9-hour day, also allowing for oiling and cleaning morning and evening. Under the new plan he will be able to make around 1200 block during the same period.

3. *Blystone Automatic.* This machine has never been operated the full 9 hours, but the record shows a production of 1275 block in 7 hours' operation. The operator of this machine does not handle the racks himself. Based on this performance, a production of 1638 block on this machine can be expected for a full 9 hours' operation. The Blystone machine in this plant must not be confused

with one that had previously been used in Detroit. Ours is a new improved machine.

Summary

Taking, therefore, only the actual production records of these machines we have:

1—Universal Down Face Machine	750 block (9 hours)
2—Universal Stripper	1022 block (9 hours)
3—Blystone Automatic	1275 block (7 hours)
Total	3047 block

Adjusting the Blystone production on a 9-hour basis we have 1638 block instead of 1275, making a total for the full 9-hour day 3410 block. The actual production records given were made with a force of only 6 men and these are the basis for the disputed statement.

Stockpiling

One of the statements made in the previous article that drew considerable comment was that only one man was needed to stockpile 3200 block per 9-hour day. This need not cause wonder; neither have we super-men on our payroll.

Our racks, as ordinarily loaded, carry 54 block. Therefore approximately 60 racks are needed to carry 3200 blocks from the machines to the stockpile. This allows 9 minutes for stockpiling the block on each rack. As a matter of fact only 4 minutes is actually needed to do the work. (Ed. Note: The Editor actually timed this operation and found that racks were unloaded at the rate of 3½ minutes per rack. This allowed a 5½ minute resting spell between racks, if the workman wanted it.)

The stockpile man does not touch the racks or the pallets. The lift truck operator brings them out into the yard, spotting them where they will be most convenient. When the lift truck man takes back an empty rack, he gathers up the pallets and, when he places the empty rack near the machine, he puts the pallets in the cage at the machine.

The lift truck man must move 10 full racks from the machines and return 10 empty racks each hour. That means that he must make only 10 trips (at the maximum) from the machines to the stockpile per hour. As the maximum distance to be travelled is only 125 feet, he is required to travel only 2500 feet or less than half a mile in an hour. As he travels at a much faster rate than this (about 6 miles per hour) he has time to pick up and replace pallets, spot the racks, turn around, and sometimes help the man who places the block on the stockpile.

If further evidence is needed of the ability of one man to stockpile 3200 block per day, it can be found in the records of truck deliveries. Day after day our records show that truck men deliver up to 1500 block in a 10 hour day. That means that the truck man must load and unload 1500 block and deliver them besides. He is in effect handling 3000 block (loading 1500 and unloading 1500) under even more difficult conditions than the stockpiler has to contend with.

The man who has the hardest job in the plant is the mixer man. He takes care of all the proportioning, mixing and unloading of materials. During the past year his work has been complicated by the methods used for handling cement, but with the improvements being made, (as described in the previous article) his work will be lightened considerably.

Every man on our payroll has been with this company for at least 5 years, and some of them much longer. Only one man is kept during the winter under average conditions, unless extensive plant improvements are being made. The others are laid off when the plant shuts down, but are taken back in the spring.

Our low overhead is one of the reasons for our low costs. There is no plant foreman and no salesman, though we expect to employ one next season. A girl does all the office work and up to the present, I myself have managed the plant and looked after the selling end.

Because of the extensive alterations that have been underway, we have not been able to keep a very complete cost record. Our books, of course, give us a fairly accurate record. We get only about 17 block per sack of cement. We find that, based on a 300,000 block production, our costs are approximately as follows:

Cement	$ .03 per block
Stone	.02 per block
Labor	.025 per block
Interest on Investment	.010 per block
Total	$ .085 per block in the yard

This, of course, does not include my own salary, which is also the sales cost. We have not spent money for advertising, and our equipment maintenance is figured in with the labor cost because our men make their own repairs. We have had very little loss due to breakage and bad debts—not more than $300.00 during the entire time I have operated the plant. These costs, exclusive of my salary, are not over half a cent per block, computed on the same basis.

In closing, I want to extend a cordial invitation to anyone interested to visit the plant when it will be in operation in the spring. I will be glad to demonstrate at the plant any of the statements made.

Nebraska Products Men to Meet at Omaha

The Nebraska Concrete Products Association will hold its annual convention at the Rome Hotel at Omaha, Nebr., on January 18th. Representatives of the National Concrete Products Association and the Portland Cement Association will address the meeting. A banquet in the evening will close the session. An invitation to attend is extended to all Nebraska products men.

Coming Conventions

January 4th, 5th, 6th–National Sand and Gravel Association, at the Book-Cadillac Hotel, Detroit, Michigan. Annual convention and machinery exhibit.

January 9th to 13th–American Road Builders' Association. Cleveland, Ohio. Convention and Road Show.

January 23rd to 27th—Associated General Contractors of America, at West Baden Springs Hotel, West Baden, Indiana. Convention and national construction exposition.

January 16th to 19th—National Crushed Stone Association. West Baden Springs, West Baden, Indiana. Eleventh annual convention and exhibition of quarry equipment and machinery.

February 28th, 29th, March 1st—American Concrete Institute, at Benjamin Franklin Hotel, Philadelphia, Pa. Twenty-fourth annual convention.

March 19th to 21st—Concrete Reinforcing Steel Institute, at Edgewater Gulf Hotel, Biloxi, Mississippi. Fourth annual meeting.

Concrete Pavement Opened to Heavy Traffic at Age of 46 Hours

A Description of the Methods Used to Secure High Early Strengths with Standard Portland Cement on a Cold Weather Pavement Construction Job

A SECTION of the concrete pavement on "Y" Street, Wyandotte, Michigan, was opened to heavy truck traffic at the age of 46 hours, or less than two days after the concrete was placed. Test specimens representing that part of the pavement traversed by the heavily loaded trucks showed compressive strengths well in excess of 2000 pounds per square inch. The remarkable results were obtained by careful control of the water-cement ratio, careful selection of the aggregates and thorough mixing. A standard portland cement capable of producing high early strength concrete was used.

The "Y" Street pavement is 24 feet wide and extends from Biddle Avenue eastward a distance of 565 feet, in the vicinity of the New Wyandotte cement plant. The pavement slab is of the thickened edge type, 10 inches thick at the edges and tapering to 8 inches at a distance of 2 feet from the edges.

Premoulded bituminous joint strips were placed across the pavement at 40-foot intervals to provide expansion joints in the finished pavement. Longitudinal steel separators were placed in the bottom of the slab along the center line of the pavement.

A Cold Weather Job

As construction work was carried on during the month of November last year, the usual precautions for concreting in cold weather were observed and the concrete maintained at a temperature of at least 50 degrees Fahrenheit during the curing period. Atmospheric temperatures remained around freezing during the day's run and below freezing at night. Steam pipes circulating steam through the aggregates in the loading hoppers were used to preheat the aggregates.

The specification under which the pavement was built included a modification of the so-called water-ratio specification of concrete. It was intended, in writing the specification, that the constructor should be permitted within certain limits, to use such aggregates and proportions as in his own judgment would produce proper economy and workability. Uniform strength was assured by keeping the water-cement ratio constant and the necessary consistency was obtained by varying the proportions of the aggregates as desired.

For the purpose of estimating quantities, a 1:1½:3 mix was recommended but this was not considered as a rigid specification because the exact proportions necessarily depended upon grading characteristics of the aggregates actually supplied. Instead of specifying the average water-cement ratio desired with a definite tolerance, the maximum permissible value was given, requiring the contractor to so conduct his operations that this maximum should at no time be exceeded. In this way the contractor was enabled to obtain increased economy as his methods of controlling the amount of mixing water were perfected.

The concrete was proportioned to give the necessary workability with the use of not to exceed 4½ U. S. gallons

Showing paving operations under way. The new pavement was opened to truck traffic 46 hours after it was completed. In the background is the New Wyandotte cement plant of water per sack of cement. The mixes were proportioned for somewhat lower ratios so that with the normal fluctuations from batch to batch, this ratio was not exceeded. Water or moisture contained in the aggregate was included in computing the water-cement ratio. This moisture in the aggregate was measured within a limit of accuracy of two pounds of water in 100 pounds of aggregate.

The slump tests taken in conjunction with the sample compression cylinders, showed slumps ranging from one inch to four and one-half inches. This range of slumps was necessitated because of the fact that the concrete was hand finished, requiring a wetter mix and consequently greater slump at times than would have been required for machine finishing.

Cylinders for making compression tests. The slump of a concrete sample is being measured

It was specified that the proportion of fine and coarse aggregate should be maintained so that the ratio of the coarse to the fine was not less than one nor more than two and the amount of coarse material was governed so as to avoid harshness in placing or honeycombing in the pavement.

Finishing and striking off the pavement

Strength Tests

Frequent tests were made throughout the work to determine the quality of the concrete. These tests consisted of compressive strength tests on 6 x 12-inch cylinders at the ages of 2, 3, 7, and 28 days. A table giving 1, 3, and 7 day briquette tests shows that the grand average of the tests made exceeds at one day the 7-day requirement of the standard specifications of the American Society for Testing Materials, and at 3 days exceeds the 28-day requirement specified for standard portland cement.

Method of protecting the newly placed concrete against freezing

Because of the fact that the test specimens were cured on the work for 3 days before being transferred to the laboratory, the test results obtained were a better indication of the actual strengths developed in the pavement than might otherwise have been obtained.

The aggregates consisted of Oxford sand with a fineness modulus of 2.97 and gravel with a fineness modulus of 7.73. The actual proportion used, or the real mix, was 1:1.5:2.6, or seven sacks of cement to 11.3 cubic feet of sand to 18 cubic feet of pebbles. The sand tested contained 6 per cent moisture and bulked 10 per cent.

The equipment used in the paving operations included a 21-E Rex Paver. The paving course was hand tamped and finished, and the mixing time of each batch was at least 3 minutes.

Calcium chloride to the extent of 2 per cent by weight of the cement was added to the concrete of certain sections of the pavement, including that part subjected to the early traffic load.

The severe test of the two-day-old pavement was made by subjecting it to traffic load of a truck and three trailers. The truck, weighing 14,900 pounds, was loaded with 180 sacks of cement and each trailer was loaded with 200

Truck and trailers being supported by the 2-day-old concrete pavement. The truck weighed 14,900 pounds and was loaded with 180 sacks of cement. The trailers carried 200 sacks

sacks of cement.

The opening of the pavement to traffic was witnessed by a number of engineers, including the city engineer and other public officials of Wyandotte, and engineers of the Detroit Department of Public Works, all of whom expressed considerable interest in the demonstration of the high early strength of the concrete.

A careful inspection of the pavement after it has been subjected to extremely heavy truck traffic for almost a year shows it to be in perfect condition without the appearance of a single crack regardless of the fact that the concrete was placed in cold weather and opened to traffic on the second day after finishing.

Summary of cylinder tests representing concrete in pavement on "Y" Street, Wyandotte, Mich. The concreting was completed at 5 P. M. November 4, 1926, and opened to traffic at age of 46 hours when specimens representing that part of pavement showed a strength in excess of 2,000 lbs. per sq. in. Atmospheric temperatures remained around freezing during the day's run and below freezing at night.

Aggregates: Oxford sand (F. M. 2.97) and gravel (F. M. 7.73)
Tests: *By Detroit Testing Laboratory
Dates: Nov. 1-4, inc., 1926
Mix (Real)†: 1:1.5:2.6 (7 sacks cement : 11.3 cu. ft. ‡sand : 18 cu. ft. pebbles)
First Load: 180 sacks and 14,900-lb. truck.

Cylinder Identification	Slump (Inches)	Compressive Strength (Lbs. per sq. in.) Av. for 2 cylinders	Age (Days)
1 & 13	2 & 3½	1480	1
3 & 4	4	2245	2
5 & 20	4 & 3	3020	3
22	2	3610	4
8 & 15	2 & 2½	4500	7
9 & 17	3 & 2½	5395	28
11 & 12	3½ & 4	6540	62

*Specimens cured on work 3 days, then in laboratory; tested damp.

†Two per cent $CaCl_2$ by weight, cement added except where indicated. That part of pavement submitted to early traffic contained $CaCl_2$.

‡Sand contained 6 per cent moisture and bulked 10 per cent.

Mexico Sending Representatives to Road Show

Mexico and Cuba will join with other nations of South and Central America in sending delegations to the convention and road show of the American Road Builders Association to be held in Cleveland during the week of January 9th.

The delegation will assist in materializing plans for an international highway through the United States and Mexico to Central and South America.

The Mexican government will send a complete exhibit of the national highway system to the exposition.

Northwest Products Men Hold Third Annual Meeting

Northwest concrete products manufacturers will gather at the Multnomah Hotel at Portland, Oregon, on January 13th and 14th, for the third annual meeting of the Northwest Concrete Products Association.

An invitation is extended to all who are interested in the manufacture of concrete products to attend, even though they are not members.

The New Economical Way to Buy Building

By G. SZMAK, Economist

An economical purchase is the result of positively knowing why, how and what to buy. To replace the wasteful and uncertain methods of buying building, which do not assure the buyer quantity, quality or economical price, there has developed during the past fifteen years a new and efficient service. The buyer may now receive a positive record of his purchase, showing the exact quantity and quality of materials and workmanship, in uniform units of measurement. With the aid of this record the buyer can determine the exact cost of his purchase based on the unit prices bid for the work by contractors. This system gives the buyer absolute assurance without having to take the word of anyone for the fairness, accuracy and economy of his purchase. The record or instrument of purchase known as a construction survey shows the exact quantity and quality of materials and labor required to erect the building.

Construction surveys are now recommended by up-to-date architects and builders because it helps them to give the buyer better service at a cheaper price. The construction survey is a measurement and tabulation prepared from the architect's plans and specifications just before the drawings are submitted to contractors for bids. This survey accompanies the plans and specifications and forms an exact basis for the contractor's bids without possible variation or misinterpretation, which always reflect to the disadvantage of the buyer because it is only reasonable for contractors to protect themselves against possible loss. It always costs a good deal of money not to state or know the facts, whether you are buying a suit or a building.

The buyer is now in position to use the facts merely by having the architect or engineer provide a professional construction survey with the plans and specifications. The cost of the survey is known to the buyer in advance and it may be included in the contract of the builder. Therefore it need not be a burden of expense to the buyer any more than under the old system. In fact it costs less than before, because it does not involve a wasteful duplication of surveys. Under the old system, a survey of some sort is prepared by each contractor, sub-contractor and dealer bidding on the work. However, the buyer does not receive the direct benefit of these surveys.

The cost of a professional survey is only paid for once, whereas under the old system the expense of surveying is as manifold as there are contractors, sub-contractors and dealers bidding on the materials and labor required for the building. Under the new system there is only one professional survey prepared to serve all purposes of the owner, architect, contractor, sub-contractors and dealers regardless of the number of bidders on the work. This means the elimination of one or two hundred surveys on jobs of any importance, which is unquestionably a great saving to the buyer.

Just as land surveyors assure a correct purchase of property through their survey, the construction surveyor likewise assures the buyer on the correct purchase of construction in every respect. The saving derived through using a professional survey will safely average as high as 10 per cent plus the increased value of materials and workmanship, which are added to the life of your building by stating and knowing the facts concerning your purchase.

Highway Bridge Destruction Tests

Water Power Developments Present Opportunity for Making Unusual Series of Tests on a Concrete Arch Bridge in North Carolina—Bridge To Be Tested to Destruction—Will Study Concrete Arch Stresses—Scope of Tests—Method of Making Tests—Engineering Societies Co-operate

By N. C. McLOUD

DESTRUCTION tests on a concrete highway bridge are so unique as to command widespread attention at the hands of engineers. The first opportunity for complete experiments of this nature has been afforded by recent water-power developments in North Carolina, with results that promise to exert far-reaching influence on bridge design and construction.

The bridge which invited destruction was the 1069-foot structure spanning the Yadkin River on a Federal-aid highway between Albemarle and Mt. Gilead. Erected in 1922, the bridge was a part of the North Carolina State highway system. Although still as good as new, the structure was scheduled for early removal because of its prospective inundation by waters impounded through the erection of a water-power dam a few miles further down the Yadkin. The abandonment of the bridge, and its replacement by a new span at a point above the new high-water level, made possible investigations of a type never before undertaken with reference to reinforced concrete arch stresses.

This bridge consists of three open-spandrel arch spans, each of them approximately 150 feet in length, and 14 T-beam or deck-girder spans of approximately 40 feet each. The length of 1069 feet is overall, from face to face of the end bents.

For the purpose of giving greater value to the destruction studies, the investigation was thoroughly organized in advance of the actual work. The operations have been conducted by the two agencies which were responsible for the original construction—the North Carolina State Highway Commission and the United States Bureau of Public Roads. Co-operating with these agencies there has been an advisory committee of distinguished engineers representing important organizations. The agencies thus participating included the University of North Carolina, North Carolina State College, the American Association of State Highway Officials, the American Society of Civil Engineers, the American Railway Engineering Association, the American Concrete Institute, the Highway Research Board, the United States Bureau of Standards, and the American Society for Testing Materials.

The Yadkin River Bridge, with one of the loading tanks in the center

Scope of Tests

During the progress of the study the temperature of the concrete has been determined at various depths in the arch ring by means of thermometers placed in holes drilled in the arch and previously filled with cup grease. Simultaneously with the temperature readings, measurements were made of the deflection of the crown of the arch. These measurements were achieved from the datum afforded by a taut piano wire, fixed at one end, passing over a pulley, and at the other end carrying a weight to maintain uniform tension. Preliminary temperature studies were made for the purpose of correcting for temperature the results obtained in the subsequent loading tests.

In arranging a program of operations, the official agencies and the advisory committee determined to divide the study into two parts. The first phase involved the structure as it stood before it was closed to traffic. The second phase dealt with the bridge after the continuity of structure had been destroyed by the removal of sections of the flooring, to prevent the distribution of strain.

In the first stage there were loading tests of exceptional force, made possible through the use of enormous wooden tanks made for the purpose. Each tank had inside dimensions of 12 by 20 by 18 feet. When empty, each tank weighed 47,000 pounds. Filled with water their weight was 160 tons apiece.

The telemeter attachment for measuring the deformation of arch under loading

In this connection it is worth while to consider the methods of weighing these mighty loads, a task involving no little engineering skill. The basic factor in this process was the deformation of supporting copper cylinders set in steel cylinders and receiving the load from closely fitting pistons. Made of specially annealed copper, the supporting cylinders were accurately shaped to dimensions of ½ inch by ½ inch. They were so placed that they carried the entire weight of a tank when the latter was placed on the pistons.

The weight was determined by comparing the deformation of the supporting cylinders with precise calibration curves previously established in laboratory tests. The accuracy of the method was checked by careful computations of the weight of the material of which the tanks were constructed, and by other check measurements. In this way the empty-tank weight of 47,000 pounds, as shown by the cylinder deformation, was checked within 300 pounds.

The instrument that records the measurements made by the telemeter

Stress Measurements

The loads were used for the making of stress measurements to determine the manner in which a full-sized con-

Falsework under the bridge providing platforms on which observers stand to study the effects of loading

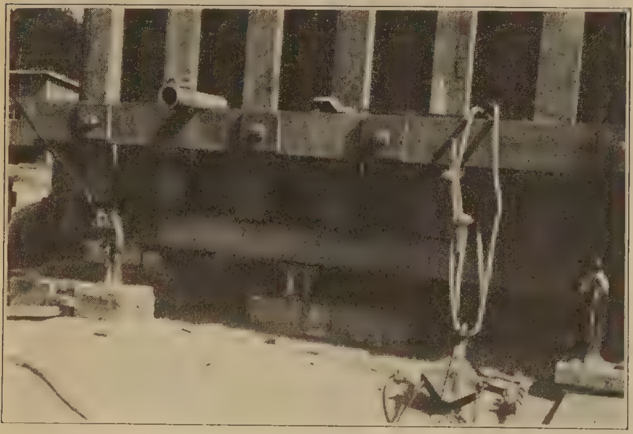
crete arch built under normal conditions deforms under determinate loads. A further purpose of the measurements was to compare these deformations, and the stresses produced in the arch rib, with the deformations and stresses as computed by the generally accepted elastic theory of arches and those derived from the tests of models by means of the Beggs deformeter gages. To accomplish these things the loads were imposed in all possible positions on the span.

In the first phase of the loading tests, a complete series of loads was imposed on the bridge as it stood, using one tank, with no other damage than the development of surface cracks on the under side of the arch. The second phase involved a complete series of loads after the engineers had destroyed the continuity of the structure. This latter work is for the purpose of approximating as nearly as possible the conditions generally assumed in designing arches. A single tank was used in this phase, as in the first.

A third and final phase will be introduced, which involves loading the bridge in the most critical positions with the two filled tanks, giving a load of 320 tons. This loading will represent an effort to cripple the arch rib.

The first and second phases of the experimentation involve various measurements, taken with the load placed in all possible positions, and with three stages of water-content for each position of the tank. The first measurements dealt with the deformation of the concrete and steel at 24 points on the arch rib. From these measurements the stress is determined by the use of the modulus of elasticity derived from tests of specimens taken from the bridge.

The instrument used in measuring the deformation is an electric telemeter designed on the principle that the electrical resistance of a carbon pile varies with the pressure on the pile. The instrument is attached to steel plugs grouted in the concrete arch rib in such manner that the deformation movements are transmitted as pressures upon the carbon piles. The telemeters are read to one ten-thousandth of an inch, and estimated to a hundred-thousandth.

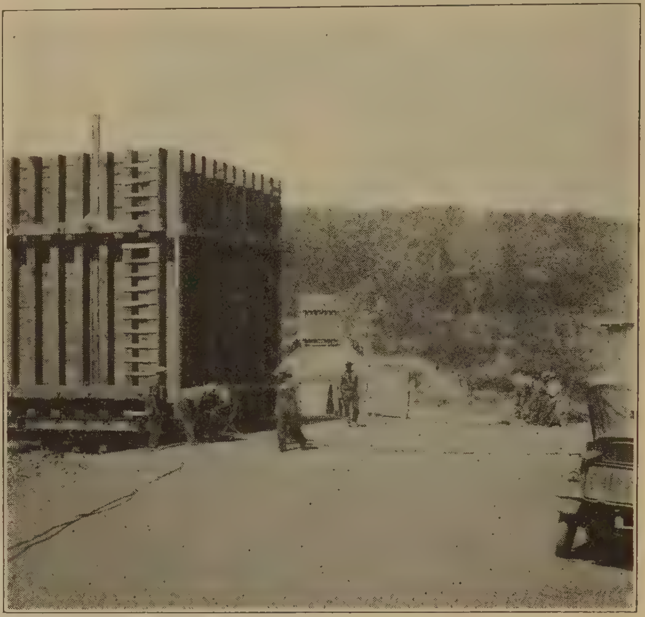


Weighing one of the tanks by measuring the extent to which the weight compresses copper cylinders

Other Stress Measurements

Other measurements in the first and second phases have to do with the angular rotation of the axis of the bridge at nine points. The instrument used for this purpose is a clinometer consisting of a steel bar carrying a level-bubble and a leveling screw attached to a dial reading to one one-thousandth of an inch. The instrument is placed and leveled on gage points located 20 inches apart on steel plugs in the arch rib. The relative displacement of the gage points is measured, and from these measurements it is possible to derive directly the angular rotation under any increment of load.

Still further measurements in the first and second phases deal with the changes in the length of the middle ordinates of 5-foot arcs of the axis at 5-foot intervals over the entire length of the arch rib. The instrument used for these measurements was a radius meter, consisting of a steel bar five feet long, carrying at its center a Federal dial reading to one ten-thousandth of an inch. The gage points at the ends of the radius meter were placed on corresponding points on steel plugs in the arch, and the needle of the dial allowed to rest on the surface of a square steel plug half way between the gage points. The movements of the square plug were transferred to the needle, to be read on the dial.



One of the loads is in the foreground. Another is on the bridge

A fourth type of measurement reckons the deflection at each spandrel point of the arch. The deflections were measured from a wire suspended over a pulley with a counter weight at one end to maintain a constant tension and sag. Points were located in the concrete top of each spandrel column, and the deflections measured from these points to the wire.

The fifth set of measurements deal with the rotation of the piers at the end of the span under observation. In this work the instrument is a clinometer, employed in the same manner that was used in connection with the axial rotations, the gage points being placed on the top of each pier. These rotation measurements are checked by means of two wires placed five feet apart vertically and suspended independently of the span. Movements are shown by the relative longitudinal displacements of fixed points on the wire and on the ends of the piers.

For the third phase, in the effort to cripple the arch rib, the loading will go the limit, with both tanks. If this does not bring collapse of the arch the structure will be dynamited by the War Department.

Detailed study of the results will occupy at least 12 months.

Contractor Saves 30 Per Cent Cement Through Quality Control

Quality Control Permitted Reducing the Cement Content Per Cubic Yard of Concrete in Building the Foundations for the Greater Penobscot Building in Detroit, Michigan

By L. CHARRON
Engineer in Charge of Concrete for the Contractor

BY strictly following the now well established principles for controlling the quality of the concrete to be placed in the foundations of the Greater Penobscot Building in Detroit, the contractor was enabled to make a very considerable saving in the amount of cement required to complete the foundations.

This was one of the pioneer water-cement ratio concrete jobs in the city of Detroit. Though the architects' specifications called primarily for a concrete developing a strength of 3000 pounds per square inch at 28 days, the city building department, whose requirements also had to be met, called for a theoretical mix of 1:1:2 for 3000 pound concrete. Under the city's specifications, 11 sacks of cement were required per cubic yard of concrete. Further provisions in the architects' specifications called for fine aggregate having a fineness modulus of 3.2 and coarse aggregate having a fineness modulus of 7.9.

The contractor knew that with the modern methods of making concrete of a definite, predetermined strength, he could cut the cement content and still secure concrete well over the 3000 pound requirement if the consent of the city, the owners and the architects could be secured.

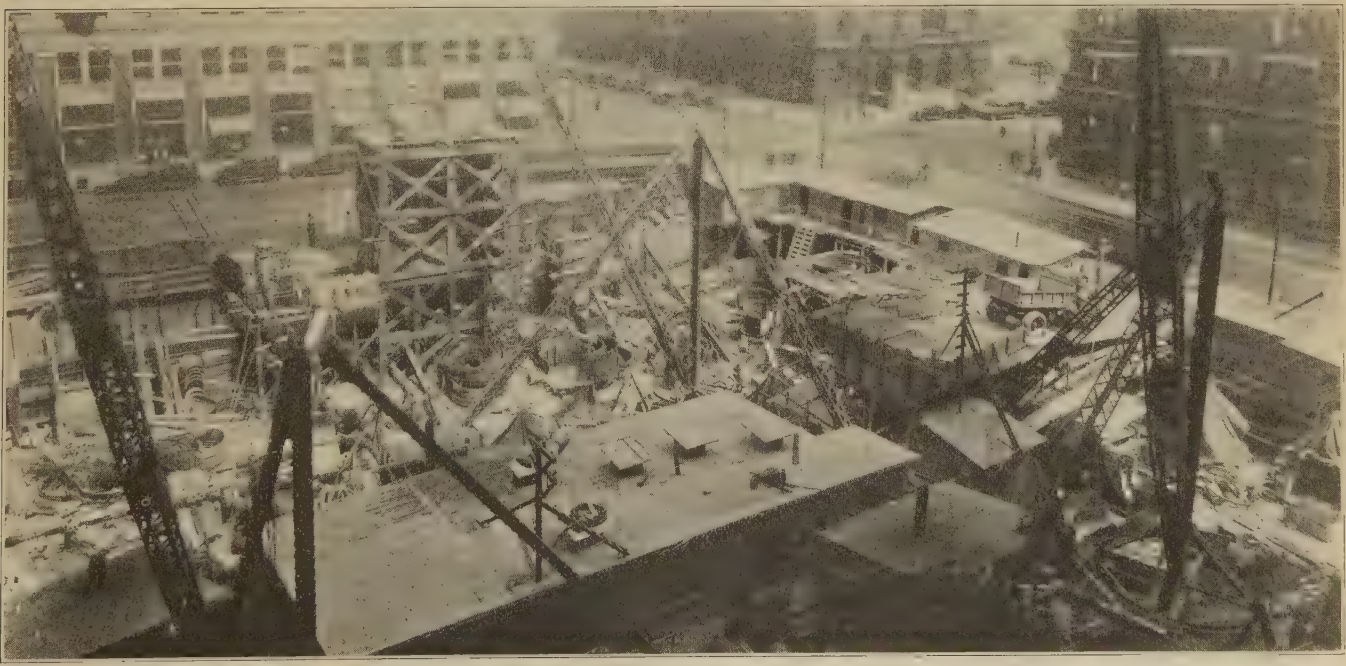
The Greater Penobscot Building is being erected in the heart of the financial district of Detroit. The completed building will be 47 stories high and will rise 565 feet above the sidewalk. It is also the first building in Detroit to have its caissons resting on bed-rock.

The project described in this article is the construction of the concrete foundation for this building. The caisson and caisson caps required the placing of approximately 9,800 cubic yards of concrete.

The original foundation plans called for 96 open well, multiple bell type caissons, but in digging one of the first wells, water was encountered in belling out. With this difficulty to face, the open well method was abandoned in favor of using compressed air and going to bed-rock, which is about 135 feet below street grade. The number of caissons was reduced from 96 to 66 when the new method was adopted.

In excavating the caissons, holes averaging 90 feet in depth were dug. Elliptical steel forms, held in place by wedges, were placed in the holes for a distance of 20 feet, the forms being in 5-foot sections. Concrete was then poured up to the required grade and the forms removed.

Small pipes were then placed to extend through this concrete shell. By means of these pipes concrete was forced under compressed air between the concrete and the lagging. When the concrete shell was poured, the forms



The northeast corner of the excavation, showing the material bins and the location of the main mixing plant and the stiff-leg derricks used to distribute the concrete removed and the grouting finished, a steel air lock was placed on top of the hole and the excavation was continued to bed-rock. Concrete for the shell was dropped through a short length of pipe centered over the forms, falling directly on top of a cone-shaped cap by which means it was spread evenly on all sides.

Concrete Plant Layout

The concrete plant consisted of a 21-S Lakewood mixer, placed beneath the material bins, so that aggregates could be dumped directly from the trucks into the hoppers, simplifying the method of handling materials. A Blaw-Knox inundator was installed to permit accurate measurement of sand and water.

Cement was unloaded at the street and sent down a gravity conveyor to the mixing platform where it was dumped directly into the hopper over the mixer.

From April 4, 1927, until June 13, all of the concrete placed was mixed in the 21-S mixer. The concrete was taken from the mixer to the different wells in steel buckets handled by means of an Erie shovel with a boom attachment.

On June 13, three stiff-leg derricks were placed on the job to transport the concrete and the crane was removed. Tracks were then built from the mixer to the stiff-leg derricks. Concrete discharged from the mixer into steel boxes of one cubic yard capacity. These were taken to the derricks on flat cars where they were picked up and dumped into the wells. This arrangement provided the necessary flexibility, permitting the placing of concrete at any point desired.

At this time, also, two 10-S mixers were purchased. It was found that when concrete was needed at several different points of the job at the same time, additional mixing and distributing facilities were required. Especially if concrete was to be placed under air pressure, it was expensive to keep the hole open waiting for concrete. The two extra mixers were bought to supply this deficiency.

These 10-S mixers were set up on the outside walls of the excavation, as shown in one of the accompanying illustrations. With these mixers, we were able to pour concrete within a considerable area by simply placing a few chutes. The small mixers were not equipped with inundators. While they did have automatic water tanks, a water glass was added to insure accuracy in measuring the mixing water. A lot of time was saved by the use of these small mixers, since they could be picked up by the derricks and placed wherever they would be needed.

Aggregates and Mixes

The first aggregates used were sand with a fineness modulus of 3.2 and crushed limestone with a fineness modulus of 7.9. Later it was thought desirable to eliminate the limestone because of the sulphate water and also because it was noted that the limestone always sheared through in the compression test, and pebbles passing a 2-inch screen and having a fineness modulus of 7.9 were substituted.

Screen tests on both fine and coarse aggregates showed that the fineness modulus throughout the job varied only within the following limits:

Stone	7.5 to 7.9
Sand	3.0 to 3.2

Since the mix was overdesigned as to sand, the mix was not changed very often to accommodate the very small differences caused by the change in the fineness modulus. Separate aggregates were used throughout the job.

The materials used at the large mixing plant were:

Limestone, F. M. 7.9; Sand F. M. 3.2 (inundated).

Pebbles, F. M. 7.9; Sand F. M. 3.2 (inundated).

All the mixes were designed by Abrams' theory and checked by trial for density.

The first concrete placed in the shells or cores was poured with a 2-inch slump, but it was found that this concrete was not plastic enough, so the slump was changed

To the left is the large mixing plant. Note the narrow gauge track in front of the bins. Skips filled with concrete are carried on trucks to a point where the derricks pick them up and swing them over the caissons to 5 inches for concrete placed under air and to 7 inches for core concrete.

Quality Control Saves Cement

Inundation was not specified on this job, but the contractor realized that if he was going to show the City and the owners that concrete of the required quality could be made with less than 11 sacks of cement per cubic yard, he would have to satisfy them that he intended to adopt all the aids to accurate control available.

When the plant was erected, the contractor made a series of tests in co-operation with the city inspector to determine what strengths could be secured with the water-cement ratio method of proportioning. Several tests using designed mixes were made.

Special Tests Conducted Under City Supervision

Type of Concrete	W/C Ratio gals. per sack of cement	7-day Strengths lbs. per sq. in.	28-day Strengths lbs. per sq. in.
Curve A—3000 lb.	6.	2460	4315
Curve B—3000 lb.	5.25	2890	4492
Curve A—4000 lb.	4.75	3260	6243
Curve B—4000 lb.	4.25	4240	7216

After these tests were completed, the City granted written permission to use 10 sacks of cement per cubic yard of concrete. This mix was used from April 5th to April 18th. The concrete was used only to pour the outer shell of the caisson from the bottom of the open excavation up to the point where the air lock was installed. On April 13th super cement was substituted for standard portland cement. This change was made by the architects because of the presence of sulphate water and hydrogen sulphide gas in the wells. On April 17th the coarse aggregate was changed from limestone to pebbles.

Sixteen sets of cylinders were taken during this period, the test results being as follows:

7 Days	28 Days
3942 lbs. per sq. in.	5763 lbs. per sq. in.

On April 18th permission was granted to cut the cement content down to 8 sacks per cubic yard of concrete. This mix prevailed, still using gravel aggregate up to and including the pour on May 6th. Fourteen sets of cylinders were broken during this period with the following results:

Average of 14 Cylinders—8 Sacks Cement—Slump 7 In.

7 Days	28 Days
3196 lbs. per sq. in.	5155 lbs. per sq. in.

On May 7th permission was given to still further reduce the cement content to 7 bags of cement per cubic yard of concrete.

Tests made after this cut in cement content still showed strengths far above the requirements:

7 Sacks per cu. yd. Water-cement ratio, 6 gals. per sack.

Slump, 7 inches—Average of 12 cylinders at each age.

7 Days	28 Days
3123 lbs. per sq. in.	5155 lbs. per sq. in.

6 sacks per cu. yd.

Slump, 5 inches—Average of 21 cylinders at each age

7 Days	28 Days
3197 lbs. per sq. in.	5100 lbs. per sq. in.

Small Mixers Accepted

When the 10-S mixers with which inundation was not used were placed on the job, it was necessary to convince the City and owners that these, also, would provide concrete of the required quality, when rigid control was maintained. Test results with these mixers placed them on the same basis as the big mixing plant.

Test Results

Small Mixers. 7 sacks per cu. yd.

Slump, 7 inches—Average of 20 cylinders for each age

7 Days	28 Days
3734 lbs. per sq. in.	5494 lbs. per sq. in.

6 sacks per cu, yd.

Slump, 5 inches—Average of 36 cylinders for each age

7 Days	28 Days
3257 lbs. per sq. in.	4816 lbs. per sq. in.

In the background is one of the 10-S mixers which were installed at various points to facilitate the placing of concrete

Results for the entire job are as follows:

Average cement content per cu. yd. 7.22 sacks

28-Day Cylinders—188 Cylinders Broken

Those testing—	Per Cent
7000 lbs. and above	2.7
6000 lbs. to 7000 lbs.	19.7
5000 lbs. to 6000 lbs.	41.5
4000 lbs. to 5000 lbs.	29.2
3000 lbs. to 4000 lbs.	5.9
3000 lbs. and below	1.0
	100.0

General average—5341 lbs. per sq. in.

7-Day Cylinders—167 Cylinders Broken

Those testing—	Per Cent
6000 lbs. and above	1.2
5000 lbs. to 6000 lbs.	6.0
4000 lbs. to 5000 lbs.	24.6
3000 lbs. to 4000 lbs.	47.9
2000 lbs. to 3000 lbs.	19.1
2000 lbs. and below	1.2
	100.0

General average—3408 lbs. per sq. in.

Personnel

The foundation contractor for the job is the Walbridge-Aldinger Co., Mr. A. McDonald acting as superintendent of construction and the writer as engineer in charge of concrete for the contractor.

Smith, Hinchman and Grylls are the architects. Donaldson and Mier are consulting architects and Mr. D. R. Martin is superintendent for the architects, Mr. S. McInerney is acting as consulting engineer for the owners.

Comparative Tests on Concrete Cylinders of Different Sizes

A series of 216 concrete cylinders, mixed and made in the field, half of which were 8 by 16 inches and the remainder 10 by 20 inches, were recently tested at the Bureau of Standards. The object of the series was the determination of the comparative strengths developed by the two sizes of specimens, using local sand and gravel under field laboratory conditions.

The cylinders were made in a small field laboratory, the concrete being mixed in a small batch mixer. Each batch was large enough to make four 8 by 16 and four 10 by 20 inch cylinders. After mixing to the desired consistency, the batch was emptied into a wheelbarrow and a shovelful was placed into each of the paper cylinder molds in succession until filled. Each cylinder was properly tamped during filling.

Three mixes were used, 1:1:2, 1:1½:3, and 1:2:4. The 1:1½:3 and 1:2:4 were tested at 3, 7 and 28 days. The 1:1:2 mix was tested at 3 and 28 days. For each proportion the concrete was mixed to three consistencies giving the approximate slumps of 2, 4½, and 6½. Since the cylinders in each group have the same amount of cement, water, aggregate, and mixing time the strength ratio of the 10 by 20 and 8 by 16 should be unaffected by many of the variables which enter cylinder making when duplications of mixes are attempted.

The average strength of the 10 by 20 inch cylinders was 96 per cent of the average strength of the 8 by 16 inch cylinders. The strength ratios were 92, 98, and 96 per cent, respectively, for the 1:1:2, 1:1½:3, and 1:2:4, respectively.

New Books

Another Concrete Handbook

Concrete Building Construction. By Theodore Crane, C. E., Associate Professor of Building Construction, Sheffield Scientific School, Yale University. Edited by the late Thomas Nolan, M.S., A.M., Fellow of the American Institute of Architects and formerly Professor of Architectural Construction, University of Pennsylvania. Published by John Wiley & Sons, Inc.

The book is both an excellent text for the beginner who has nearly everything to learn about concrete work, and a convenient handbook for the man who is already familiar with concrete work as it is now being done.

The subject is covered in a very comprehensive manner, space being devoted to the principles of the design of concrete structures, the construction problems involved in the building of concrete structures, and the financial aspects of concrete construction.

The principles of design discussed are the customary ones, and so also are the various methods of handling construction problems here presented. Under the latter head are sections devoted to form work, to reinforcing, to the design, control, and placing of concrete mixtures, and to various methods of surface finishing that can be used in connection with concrete.

All this is more or less what would be expected in such a book as this one, but the material which is included on estimating, purchasing, and cost accounting is rather out of the ordinary and gives the book a completeness from the standpoint of the practical contractor that not all such handbooks possess. The way in which these subjects are handled is quite satisfactory, and we believe that most concrete contractors—even the very successful ones—can find a good deal of value to themselves in this part of the book. Detailed methods are discussed, and numerous forms are reproduced.

From what has been said it may be assumed that the book is an unusually bulky one, but this is not true. Although the amount of material contained in the volume is large, the method of handling it is very concise, with the result that the whole thing is packed into 689 pages.

Beauty in Concrete

Architectural Design in Concrete, by T. T. Bennett. Published by the Oxford University Press, American branch.

Both American and European examples have been given proper consideration in the compiling of this book. The unusual arch work practiced in Germany, the remarkable churches designed by A. and G. Perret, and the rather remarkable work done in California are among the more noteworthy types displayed.

It is notable that in the entire one hundred plates there is no example of concrete being used to imitate some other building material. In every case concrete is used undisguised, and its decorative treatment is in accordance with the natural structural qualities of the material.

Architects who are curious as to the inherent æsthetic possibilities of concrete as a building material, or whose work brings them in contact with problems involving the use of structural concrete, will find this book an extremely valuable source of information. We do not know of any successful method of handling concrete architecturally, the practicability of which has been proven in use, that does not find illustration in its pages.

Field Tests Permit Early Opening of Pavements

How the Connecticut State Highway Department Secures High Early Strength Concrete Which Permits the Use of a Shorter Curing Period

By FRANK G. FLOOD
Testing Engineer, Connecticut State Highway Department

WITH the ever increasing amount of traffic and consequent added cost of maintaining and controlling a road surface over which to pass this traffic during construction—together with the greater cost and inconvenience caused the public during such periods—the importance of securing early strength concrete and the value of determining just when the required strength is attained has been forcibly brought to the attention of this department.

A study of the cost data on reconstruction work on the Boston Post Road during 1927 shows an average expenditure of $9,800 per mile for the maintenance and control of roads to take care of the traffic until the new pavements could be opened to travel. Additional expense, in the greater amount of gasoline used, wear on tires, etc., is incurred by the public in driving over the temporary roads in place of the concrete pavement, as well as the inconvenience and delay experienced. Add this expense to that paid by the state and the importance of opening pavements to traffic at as early a time as possible, may be fully appreciated.

Until the beginning of the 1927 construction season our roads were not opened to traffic according to the strength of the concrete but were arbitrarily closed for a period of twenty-one days to afford time for proper curing. However as a result of our investigational work it was learned that the pavements could be properly cured and safely opened to traffic in a much shorter period of time when calcium chloride was incorporated in the concrete mix for curing.

Investigation Regarding Early Strength Concrete

Many of the factors which influenced the early strength of concrete were recognized but it was not known how extensively these factors affected the final results. To determine this information a laboratory investigation was made taking into account:

(1) The effect of increasing the percentage of cement by changing proportions of fine and coarse aggregate, thereby permitting a decrease in the amount of water which may be used and still obtain the same workability.

(2) The effect of increasing the time of mixing.

(3) The effect of adding calcium chloride as a curing agent and accelerator.

Approximately 500 tests on beams, cylinders, and briquettes were made in this study and every care was used to control the various conditions affecting the strength of the concrete.

A study of the results of this investigation showed: *First*—Changing the proportions from 1:2:3½ to 1:1½:2, thereby reducing the amount of fine and coarse aggregate, so that it was possible to reduce the amount of mixing

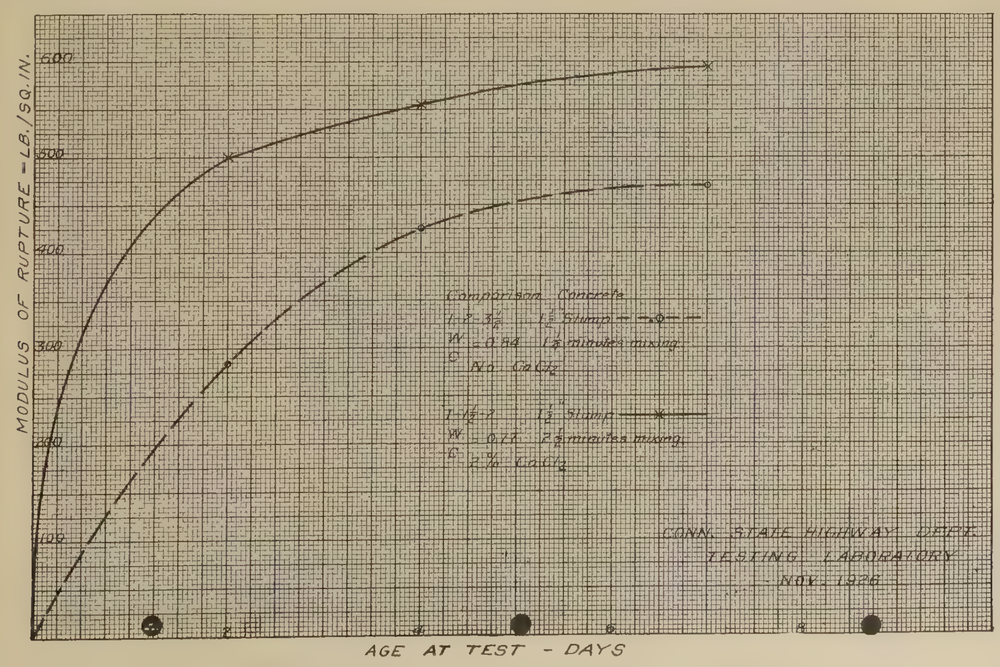


Figure 1

water, increased the strength of the concrete 14 per cent at 48 hours; 15½ at 96 hours, and 9½ per cent at seven days. *Second*—Increasing the time of mixing from 1¼ minutes to 2½ minutes, increased the strength of the concrete 23 per cent at 48 hours, 15½ per cent at 96 hours, 10 per cent at 7 days. *Third*—Adding 2 per cent by weight of the cement of calcium chloride increased the strength of the concrete 30 per cent at 48 hours, and 9½ per cent at 96 hours.

Taking all of these various factors into consideration at one time, that is, increasing the percentage of cement by changing the proportions from 1:2:3½ to 1:1½:2; increasing the time of mixing from 1¼ minutes to 2½ minutes; decreasing the amount of mixing water, and adding 2 per cent by weight of cement of calcium chloride, increased the strength of the concrete (Fig. 1) 66 2/3 per cent at 48 hours, and 20 per cent at 96 hours.

It may be noted that this increase in strength is sufficient to permit the opening of the pavement to traffic in a much shorter period of time. For special cases and for repair work it is certainly advisable to consider all of these factors.

However, for general work and for large programs of construction it is not economical to increase the percentage of cement and the time of mix, but it is economical to use calcium chloride as a curing agent and thereby provide for more uniform curing, securing at the same time an earlier strength concrete. Fig. 2 shows a comparison of specimens:—first, those cured by the incorporation of 2 per cent calcium chloride; second, those cured with wetted straw; and third, those specimens for which no provision was made for curing.

Calcium chloride incorporated in the concrete mix has been used for curing practically on all of our road concrete construction during the 1927 season and as a result it has been possible to open the pavements in less than 14 days, the period now specified before opening. In some cases pavements have been opened to traffic in as short a time as three days.

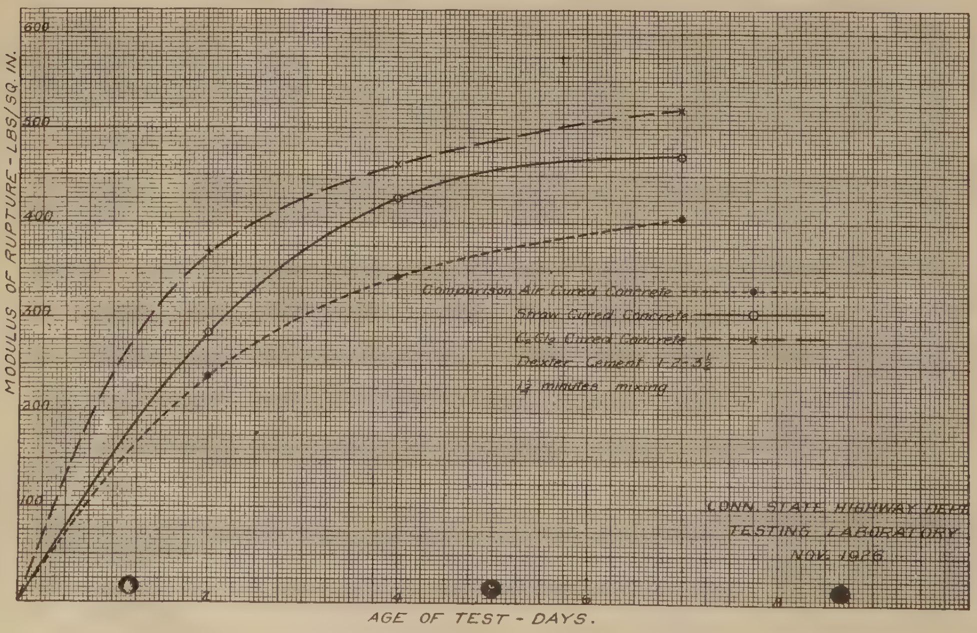


Figure 2

In order to determine when it was safe to subject the concrete to loads it was necessary to make proper tests.

Field Testing

A recent study of the design of concrete pavements indicates the fact that cross bending rather than compression strength of the concrete is the controlling factor for determining when it is safe to open a pavement to traffic. Considering this fact and in an endeavor to determine the strength of the concrete under the same conditions as those which pertain to the pavement concrete, beam specimens were made daily on the job. The test specimens were made from the same concrete used in the pavement and cured beside the road so that they were subjected to the same actual field conditions. These specimens were tested in cantilever in the field by a simple portable testing machine mounted on a truck, shown in Fig. 3. The machine consists of an extension arm which may be fastened to the free end of the specimen supported in cantilever. The load is easily applied and measured with a dynamometer. Two breaks may be made on each 30-inch specimen which affords an excellent check on the tests.

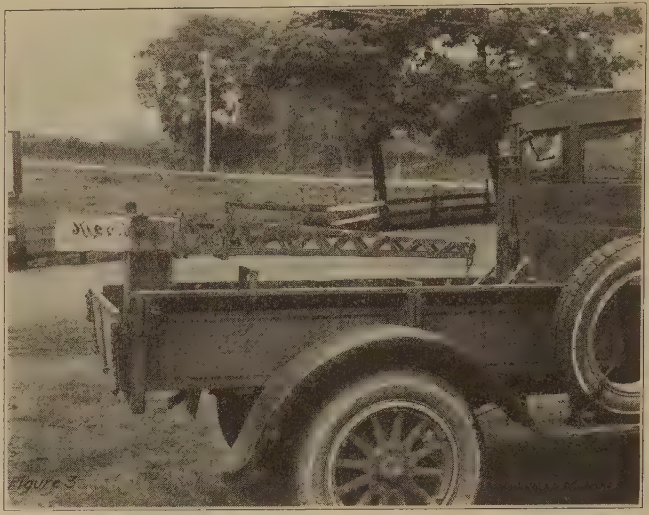


Figure 3

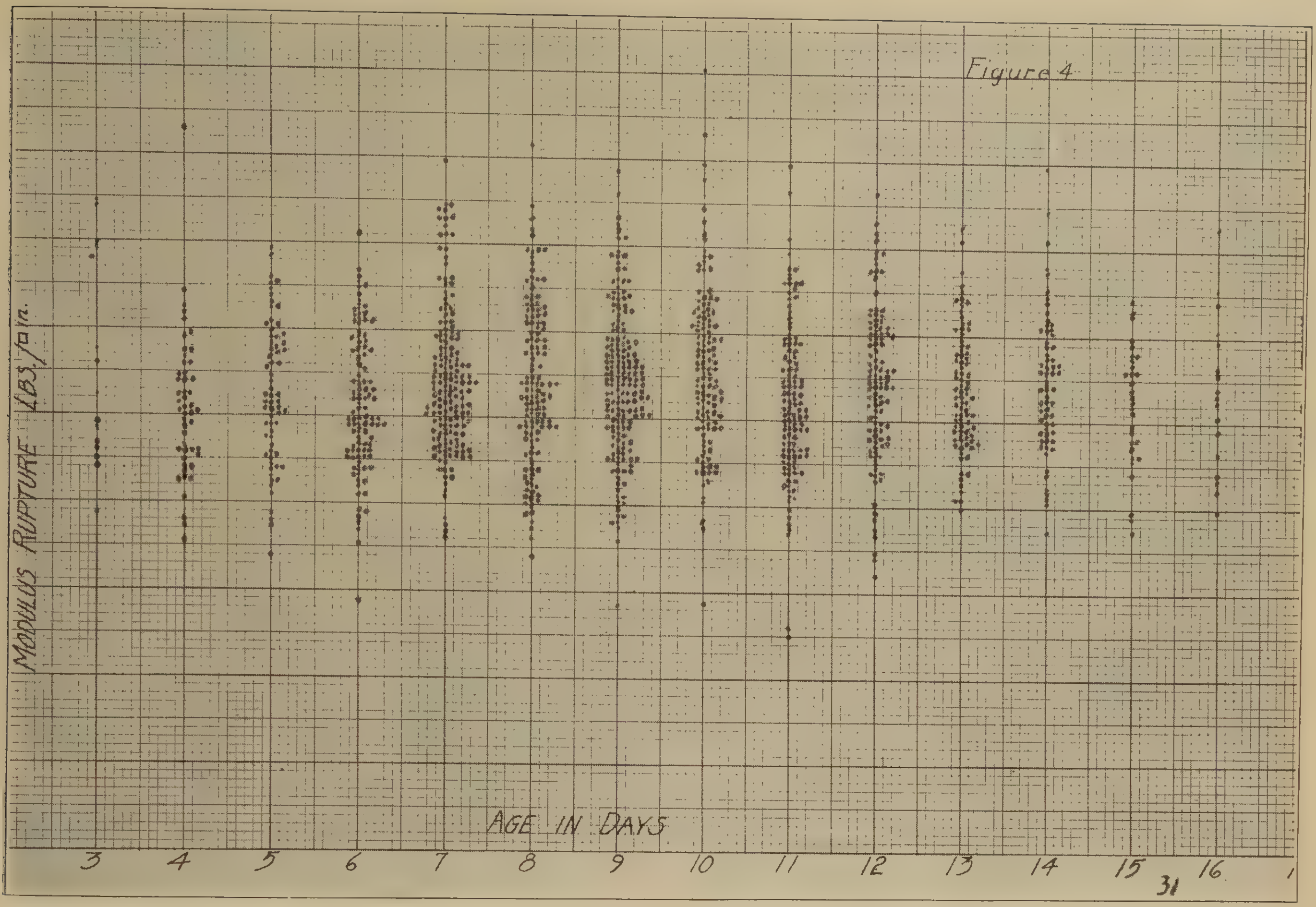


Figure 4

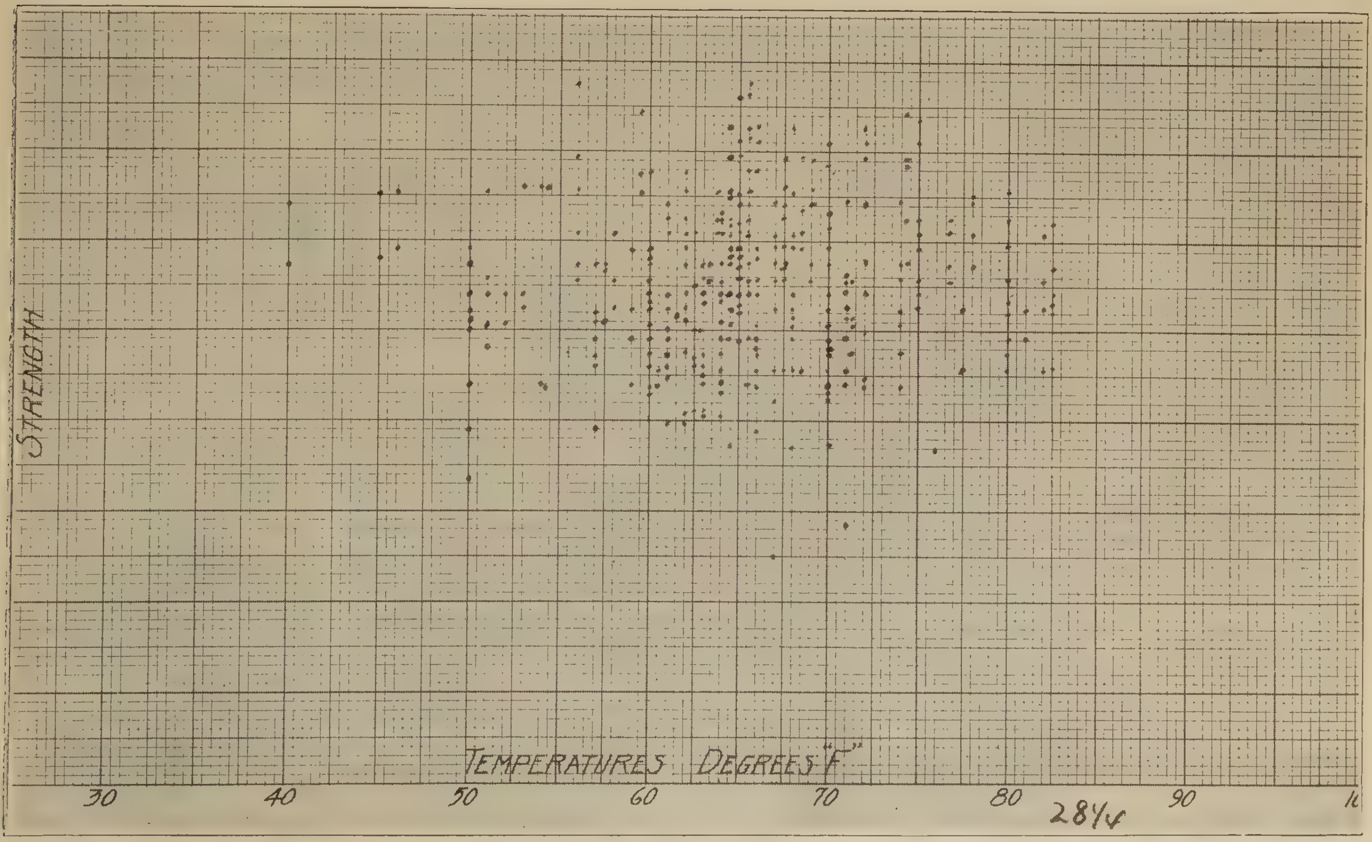


Figure 5

Tests at early ages were made according to the importance of the road.

The test specimens were made by the inspector on the job who also noted the following data: (1) date; (2) section of road; (3) general weather conditions; (4) sources of materials; (5) amount of water being used; (6) slump; (7) cement ratio; (8) general remarks.

The tests are made by the Testing Engineer and with this complete information an excellent check is afforded on all the factors affecting the strength of the concrete. As soon as the tests indicated that the concrete had gained strength sufficient to support the maximum load for which the pavement was designed the road was opened to public traffic.

The data plotted on chart No. 4 shows the strength of concrete as determined by tests at different ages. As will be noted, a large per cent of the strength of the concrete is obtained in the first few days, proving that seven day opening is very practical under these tests.

The data plotted on chart No. 5 shows the strength of the concrete, and the temperature at the time the pavement was laid. It also shows that even though some of the concrete was laid at rather low temperatures, the acceleration caused by the addition of calcium chloride and the heat thus generated were sufficient to insure full strengths.

The advantages in securing early strength by this method of curing have been worthy of consideration in bridge work as well as pavements.

The value of recording complete data regarding concrete in construction and of obtaining field tests which represent the actual conditions, cannot be overestimated.

The value of this information in permitting, with positive safety, the opening of the pavements to the public as soon as the concrete has gained sufficient strength to withstand traffic is an economic factor which should be of greatest interest to the engineer and to the motorist alike.

New Australian Company to Manufacture Aerocrete

Under the title of Aerocrete (New South Wales), Ltd, a company has been floated in Sydney, Australia, with a capital of £50,000 ($250,000) from Aerocrete (Australia), Ltd. The new company will have the exclusive right for New South Wales (other than the Riverina and Broken Hill districts) to manufacture and sell Aerocrete.

Aerocrete, which is a Swedish invention, is a form of aerated or expanded cement. It is claimed that it is an excellent non-conductor of heat, sound and cold, and to be free from the objectionable condensation of ordinary concrete and the absorption of brickwork. It is also claimed that on account of its lightness and other qualities building costs may be reduced considerably by its use.

Short Courses in Mix Control and Design Begun

Short courses in mix design and control have again begun, in various cities throughout the country. The course in most cases consists of three sessions, and includes lectures and demonstrations. The courses are held by the Portland Cement Association and a representative of the research laboratory of the organization is in charge. No charge is made for instruction or for the necessary textbooks.

Wisconsin Concrete Products Association Meeting

The sixth annual convention of the Wisconsin Concrete Products Association will be at the new Hotel Schroeder, Milwaukee, on February 2nd and 3rd. The program has not yet been announced.

Straub Patent Not Invalid

Patent Situation in Respect to Cinder Concrete Building Units Remains Unchanged

The recent decision by Judge Bodine in the New Jersey Federal District Court at Trenton did not invalidate the Straub patent No. 1212840, as has been widely published.

While the judge did question the validity of the patent for various reasons, there is nothing in his written opinion to justify the conclusion that he intended to or did declare the patent in question invalid.

There were three suits, tried as one, in which Crozier-Straub, Inc., and Concrete Specialties Company appeared as plaintiffs, with three manufacturers of cinder blocks as defendants. The bills were dismissed, not because the defendants were infringers or because the patent was invalid, but because in the judge's opinion they were not infringing the Straub patent.

The judge finds that while the Straub patent, upheld some years ago by the Circuit Court of Appeals, covered the making of block with the run-of-the-grate cinders and ash, mixed with portland cement and water, two of these defendants were making block with cinders, sand, water and cement, and another one with lime and calcium chloride mixed with cinders, water and cement.

It is true that Judge Bodine said that "if Straub has anything, it is limited to the precise disclosure of the patent," but naturally he left any further decision regarding the patent itself to a higher court if and when these cases are appealed.

It should be further noted that the validity of the Straub patent has been upheld by a Circuit Court of Appeals and that these cases were tried in a United States district court, a court of lower jurisdiction. It is apparent, therefore, that the real question of the validity or invalidity of this patent No. 1212840 cannot be decided, in respect to these particular cases, unless and until these cases are taken to the Circuit Court of Appeals and that court reverses its former ruling.

From a casual reading of Judge Bodine's opinion, and from many published reports, many concerns in the industry have gained the impression that the Straub patent was made worthless as the result of this case, but a careful reading of the opinion certainly does not bear out this interpretation.

The short notice published in our December number, "The effect of the decision was merely a dismissal of the complaint on the ground that the defendants were not infringers, that is, that they were not making Straub block," was correct.

CONCRETE IN ARCHITECTURE

The New Pasadena City Hall—An All-Concrete Structure. The Framework Is Reinforced Concrete, Stucco-Covered. Ornaments and Figures Are of Precast Concrete Trim Stone

PASADENA, California, has just completed a magnificent city hall, the second of a group of imposing civic structures to occupy a great T-squared space in the center of the city. Not only is the size of the civic project noteworthy, but the construction features of this, the latest member of the group, are well worth study. It offers an interesting example of the uses of concrete in architecture and presented some unusual concrete construction problems.

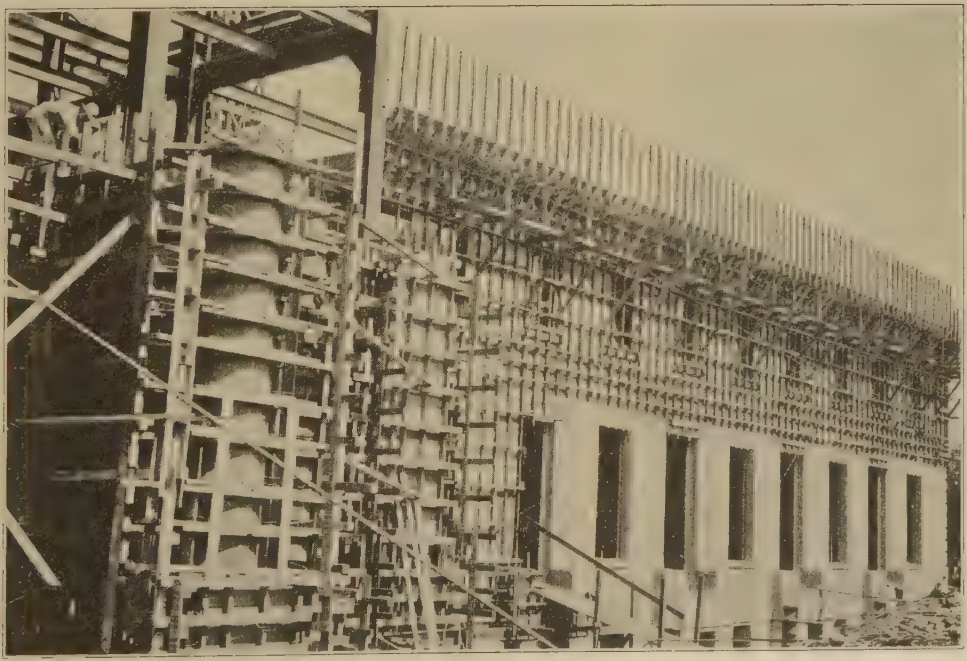
The building is based upon a Mediterranean type of architecture, although there are traces of French, Spanish and Italian influence in the structure. The general style is popular in southern California and is rapidly becoming known in this country as southern Californian architecture.

The building covers an entire city block. It is quadrangular in shape with a main frontage of 374 feet and wings 238 feet deep joined across the rear with an open arcade. The cost of the building was estimated at $1,250,000. The main section and wings are three stories in height. At the center of the main frontage a great tower rises 205 feet above the sidewalk. It is this tower that contains some of the most interesting engineering and architectural features of the new building.

Concrete Principal Material

The building is, practically speaking, a concrete structure. The framework of the main building and wings is of reinforced concrete, stucco covered outside and adorned with ornamental concrete precast trim and figures. The tower is of steel framework to the sixth floor after which it, too, is reinforced concrete for 60 feet and is topped with a steel frame dome.

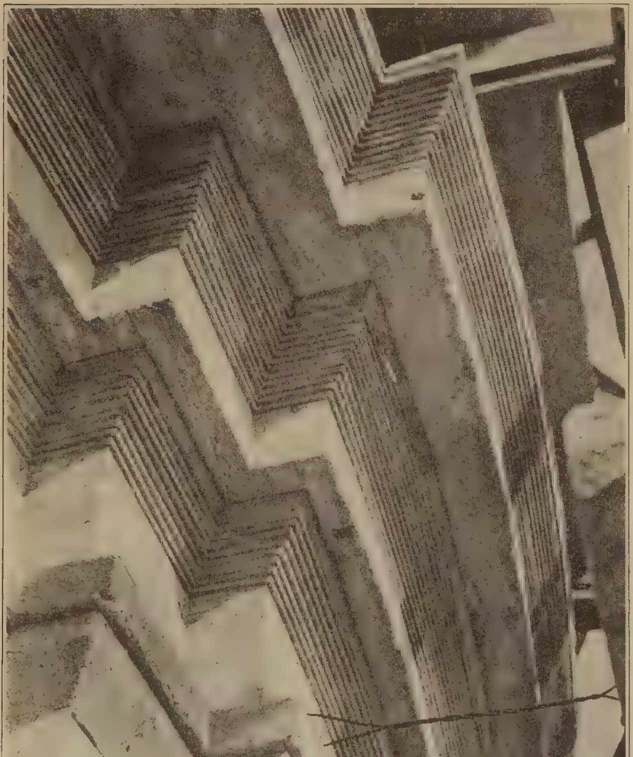
The specifications covering the concrete work on the



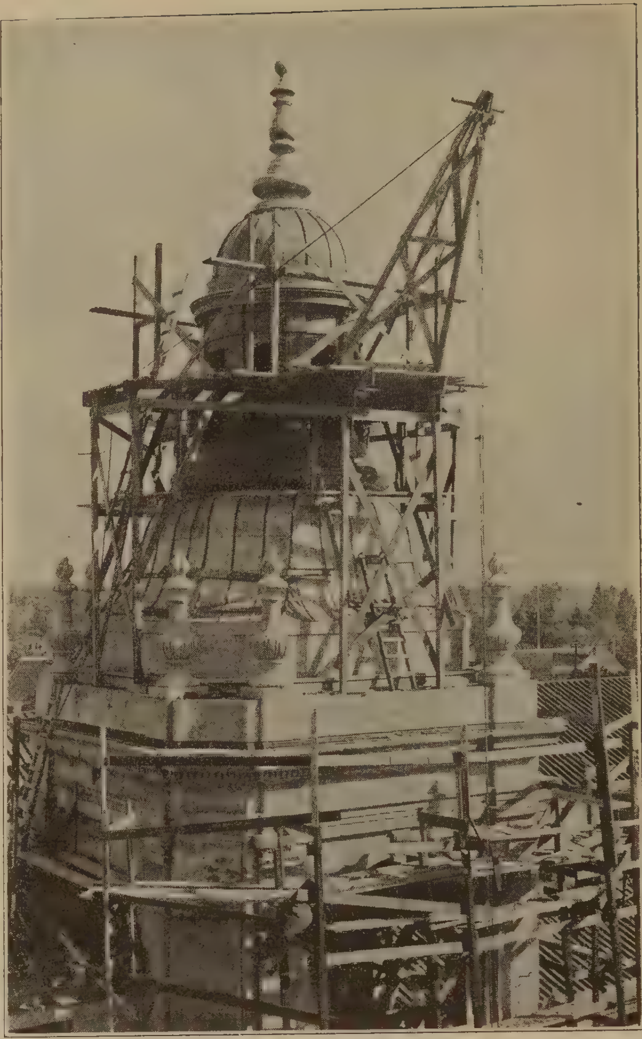
Formwork of the south wing cornice and one column of the main entrance. There are six of these reinforced concrete columns, each 3½ ft. in diameter by 27 feet high. The rustications of the main tower are carried around these columns city hall were designed to bring about uniform results with uniform strengths throughout the building. The specifications were very brief, the stipulation being that concrete with a minimum of 2000 pounds per square inch crushing strength should be always attained. The Orndorff Construction Company, the general contractor, using strength specifications as a basis adopted the inundation method of measuring aggregates. Perfect control of the mix at all times was had. The contractor used a set-up of Blaw-Knox inundation machinery consisting of batch hoppers, inundator, measuring hoppers and the accompanying scales and equipment. Once the proportions of the mix had been determined, and the equipment set to proportion the ingredients according to the desired mix, no changes were necessary even though there were changes occurring from day to day in the amount of contained moisture in the sand and aggregates. The equipment was set to control the water-cement ratio and the amount of coarse aggregate in each batch was definitely regulated. Because of the inundation, testing of sand for moisture or bulking was not necessary. Two men operated the batching plant and one mixer was sufficient to handle the concrete for the entire building.

The mix adopted was as follows: 1 part cement, 2.35 parts sand, .75 parts pea gravel and 2.90 parts rock. During construction more than 300 tests were made. Frequent slump tests were made and the average slump for the job was 6 inches. The average weight of the concrete mix was found to be 152 pounds per cubic foot.

In the structure there are 17,500 cubic feet of concrete, 1045 tons of reinforcing steel, 25 tons of copper, 26,000 square yards of exterior cement stucco, and 40,000 square yards of interior plaster, a large portion of which is cement stucco applied to the walls and ceilings of entranceways, lobbies, rotundas, etc. More than 400 different types of plaster molds were used to cast the concrete ornamentation for the exterior and interior.



Concrete as poured in laminated curved forms for the main tower at the base of the dome. This was thoroughly tamped under careful supervision. Rough concrete was formed within 1 inch of finished stucco surface

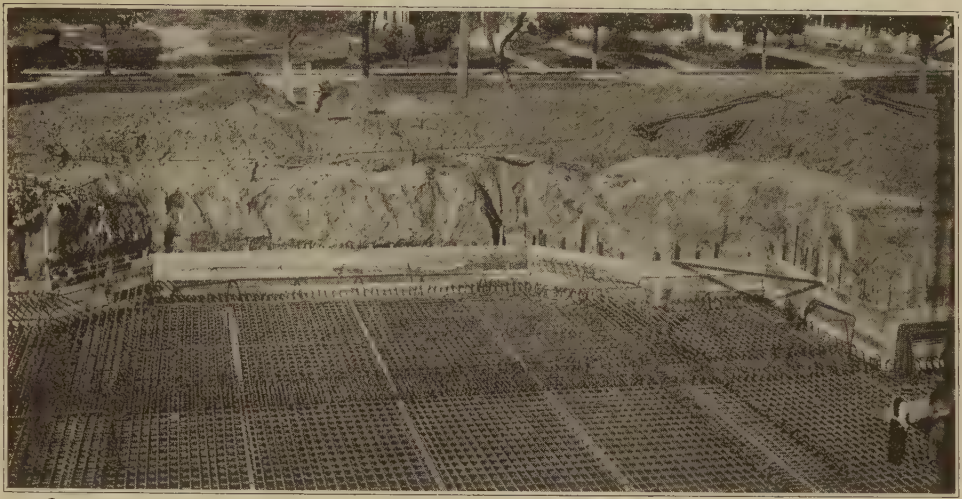


Detailed view of the stair tower cupola which is 38 ft. high. The reinforced concrete towers are surmounted by a leaded copper cupola, ornamented with 7 ft. cast stone finials representing torches

The Main Tower

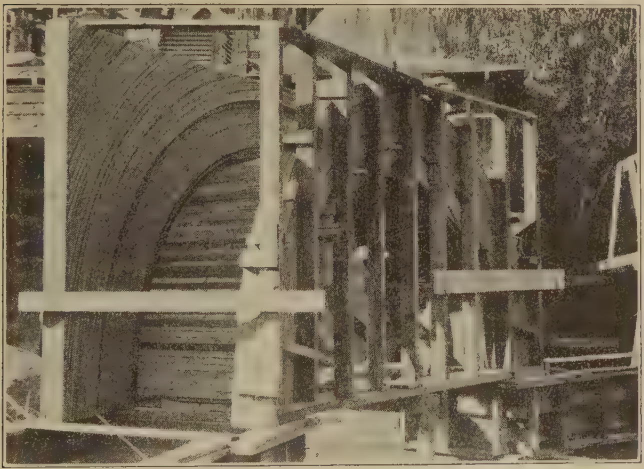
The main tower is of most interest from an engineering standpoint. This great structure rises far above the rest of the building and will be the most noticeable feature of the new civic center. The great tower is hexagonal in shape as far up as the sixth floor, beyond which it assumes a circular shape and is topped by a dome. The tower is exceedingly heavy and rests upon a great mat of reinforced concrete 100 by 104 feet in size and 5 feet thick. The mat alone required 1560 cubic yards of concrete and 169 tons of reinforcing steel for its construction. At the time the mat was poured it was acclaimed the largest mat on the Pacific Coast. The steel reinforcing formed a veritable grill of rods across the area and an idea of the size of the mat may be gained from one of the accompanying photographs. How the mat was cast was described in the June, 1926, issue of CONCRETE, on page 19.

From this foundation, twelve heavy steel columns rise to the sixth floor. Each column is encased in a heavy concrete shell. Eight of the columns are concrete-encased to the sixth floor and four are encased to the fifth floor. The four principal piers are 16 feet square at the base. This construction provides an unyielding concrete and steel structure which is designed to be safe from the heaviest earthquake tremor.



The foundation mat to support the main tower. It is 100 by 104 ft., 5 ft. thick, and reinforced with a double grill of 1¼-inch steel bars

At the sixth floor the octagonal shape ends and the circular shape begins. The dome section is carried on steel girders and is supported by the four great concrete piers carried up from the base mat. For 60 feet above the hexagonal portion of the tower, the tower is of reinforced concrete frame. The dome is 52 feet in diameter and consists of a concrete shell of 6-inch gunite covered with a "fish scale" roofing tile.



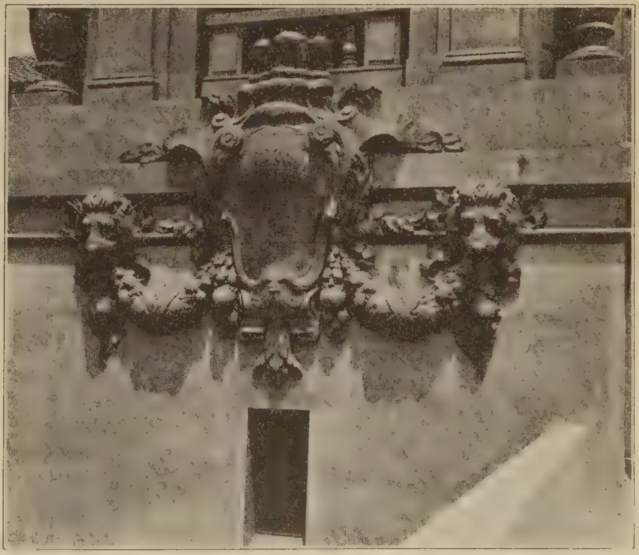
Laminated curved forms. These arches are located on the outside of a circular room which necessitates a concave face on the inside of the arch and a convex face on the outside

Concrete Products and Castings

Aside from the purely structural features of the city hall there is a wealth of interesting concrete casting and detail ornamental work about the building. Probably in no other building in southern California have the adaptability and artistic possibilities of concrete, both integral and precast, been so clearly demonstrated as on the city hall in Pasadena. More than 400 molds of different sizes and design were required to bring out the details of curves and angles in cornices, caps, bases and other intricate designs. While a stucco coat covers the exterior, the reinforced concrete work was so carefully done that exclusive of the special castings, little else was required than to follow the details of the concrete exterior.

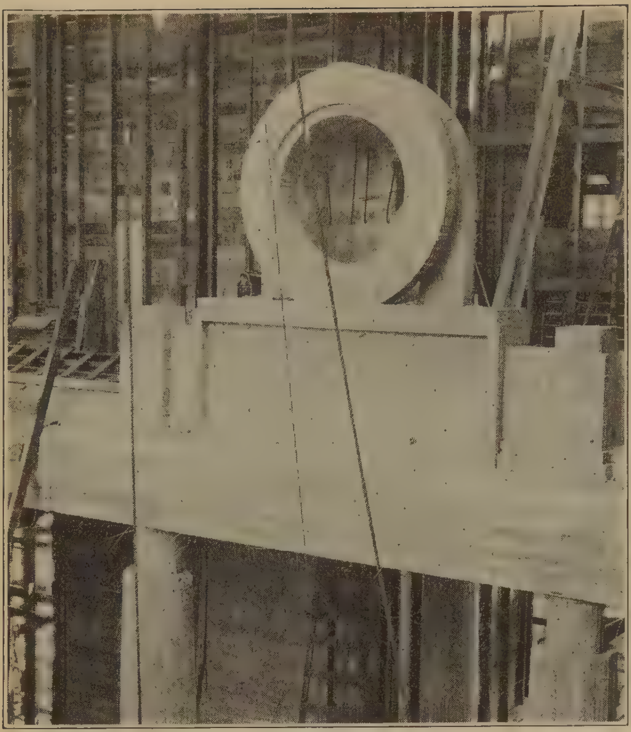
At the seventh floor level there is a belt of laminated concrete formed by placing concrete with a 7-inch slump in special laminated wooden molds. Careful supervision was required in order that no voids or pockets should occur. The rough concrete was brought out to within one inch of the finished surface on the intricate portions of the job. A view of one of these belts is shown.

A further indication of the extent to which cast-in-place concrete work was carried into intricate work is the clock which occupies a prominent position in the main tower lobby. A feature of this lobby is the doorless arches through which the great clock can be seen from the street outside. The shell of the clock is monolithic concrete. The clock is 6 feet in outside diameter and will have a 4-foot stone dial and ornaments of cast stone.



One of the concrete cast stone ornaments

There is a large number of finials, cartouches and obelisks throughout the building. The cartouches are 13 feet high and 20 feet wide and two of them adorn each of the four stair towers at the fourth floor level, or wing roof line. The finials are 7 feet high and eight are placed



The concrete clock in the vestibule. Outside diameter is 6 feet. The clock will have a cast stone dial 4 feet in diameter and ornaments of cast stone

on each stair tower. The obelisks are 15 feet high and are used only on the main tower. All of these ornamentations were cast of concrete in plaster molds. The central tower and the four stair towers are decorated with these pleasing ornamentations of scrolls, figures, obelisks, cartouches and finials. Cornices, friezes, doorways, windows and corners are set off by the use of art stone. The front of the main entrance is entirely of cast stone. All the stone work was designed and furnished by William Smith, art stone manufacturer of Pasadena.

In selecting the design for the city hall, ten architects were invited to submit designs. These designs were keyed, but not named. The winning design was submitted by Bakewell and Brown, San Francisco, designers also of the new San Francisco city hall and the new buildings at Leland Stanford University. The Orndorff Construction Company, Los Angeles, were the general contractors. W. V. Falgren, Los Angeles, stucco contractor, William Smith, Pasadena, contractor for art stone.

Further Details of A. C. I. Meeting Announced

The longest paper ever published by the American Concrete Institute, entitled "Design and Cost Data for Proposed 1928 A. C. I. Standard Building Code," will be presented at the coming Institute meeting in Philadelphia, by Arthur H. Lord, its author. Engineers who have under consideration the new Building Regulations for Reinforced Concrete, to be presented by Committee E-1, will find in this paper a method of quickly checking the relative economy of the A. C. I. code proposal as compared with other regulations.

The paper includes a complete set of designers' aids for the use of engineers in those cities where the A. C. I. code has been or may be adopted or where it is being used in the absence of a legal code. The paper includes also a study of the relative economy of various designs under the A. C. I. code.

A paper to be presented by Raymond E. Davis, professor of civil engineering at the University of California, will be entitled "Flow of Concrete Under Continued Compressive Stress." It will describe tests made in the laboratory of the university within the last two years, on concrete cylinders in which a constant, sustained compressive stress was maintained by means of car springs. Periodical measurements were made to determine plastic deformations.

Two series of tests were involved, the specimens of one of the groups of each series having been stored continuously under water and the other in air under constant temperature and humidity conditions.

Interesting features on dam construction in Tennessee will be treated in a paper by I. E. Burks, engineer of tests for the Tallassee Power Company, on its Santeetlah dam at Calderwood. Subjects Mr. Burks will discuss are mixture design and control, placing methods and the effect of removing excess water, the use of manufactured sand as fine aggregate and the effect of stone dust on the strength and absorption of concrete.

He will include also field test methods where the maximum size of coarse aggregate is 6 inches, the results of tests designed to establish the strength of concrete which is too large to be tested in the usual cylinders, and methods to establish a ratio between the strength of mortar and the strength of concrete made from that mortar.

Herbert J. Gilkey, associate professor of civil engineering, University of Colorado, is to present a paper describing "A Method for Predicting Concrete Strengths with Increased Precision."

Again, at this coming convention, the concrete cast stone industry will have a place on the program. It is expected that out of the preliminary discussion to take place may come, in the near future, specifications upon which both dry and wet method manufacturers will agree.

No announcement has been made of the products program, except that two groups of five or six ten-minute papers on timely concrete products manufacturing problems will be given.

In a paper on the price-per-pound strength basis, Robert C. Johnson of the Immel Construction Company, Fond du Lac, Wisconsin, will tell of a fall and winter job in which the contract was let on a unit price basis, materials to be purchased and supplied by the owners. In order to have control of the materials delivered to the mixer, the Immel company bid in the materials at a loss and the contract was changed to a unit price per cubic yard of concrete of 2000-lb. and 1500-lb. strength. Mr. Johnson will tell how they coped with freezing weather conditions, the problem of control, the handling of materials at all times, and the results in strength obtained, followed by an analysis of "strength contract" economies.

Institute sessions will be held at the Benjamin Franklin Hotel, Philadelphia, Pa., on February 28th to March 1st.

All-Western Road Show to Be at Los Angeles

The Western Road and Equipment Exposition will be held March 7th to 11th, at Los Angeles, California. The display and demonstrations will be held on a tract of forty acres donated by the Central Manufacturing District.

The favorable climatic conditions existing in the city in March are being counted upon to enable visitors to see machinery in competitive action under actual working conditions.

The exposition is an all-Western non-profit enterprise held under the auspices of the Western Construction Equipment Distributors.

Portland Cement Products Enrich Hollywood's Latest Movie Palace

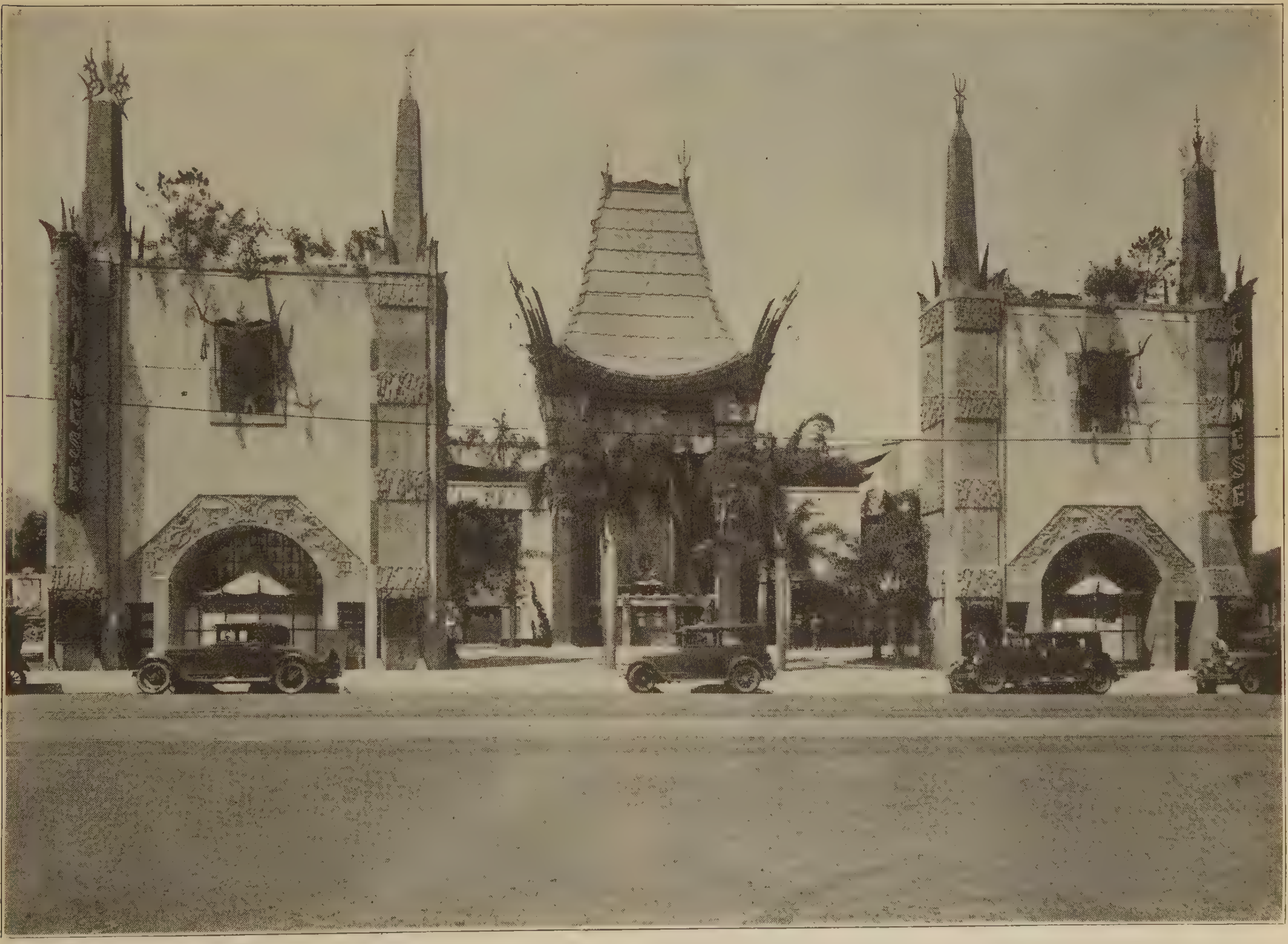
Grauman's Chinese Theatre Takes Its Architectural Motif from the Early Chinese and Selects Cement Products as Best Suited to Carry Out the Elaborate and Highly Colored Architectural Effects

GRAUMAN'S Chinese Theatre recently completed and opened in Hollywood is one of the most unique and elaborately architectured moving picture houses in the Los Angeles district, if not in the entire country. The new theatre, in which concrete was used to obtain the unusual architectural effects was designed and built by Meyer and Holler, Inc., Los Angeles.

The theatre fronts on Hollywood Boulevard in the heart of the cinema district. The building has a solid facade of masonry 40 feet high surmounted at four front corners by four ornate obelisks. The building is built U-shaped with the open end on the street. The two great ends of the U form a gigantic gateway to an oriental garden built in the form of a great elliptical forecourt hemmed in by 40-foot walls and planted with full grown palm trees after the custom of the Chinese. On opposite sides of the forecourt are two great fountain bowls, ten feet high, fashioned to represent flower bowls. Into these bowls falls a spray of water from gargoyles above. The spray is illuminated at night by jeweled lamps.

Greetings Permanently Recorded in Concrete

Probably the most interesting feature of the opening ceremonies was the printing of permanent well wishes into the walk of the court by the famous of movieland. The sidewalk was built in sections and most of the squares were allowed to cure and harden. Then, on dedication day, the alternate squares were filled in with concrete. In these fresh squares the foot and hand marks of famous stars were indelibly impressed. As shown by the accompanying photographs, prints of Norma and Constance Talmadge, Douglas Fairbanks and Mary Pickford, Gloria Swanson and others were placed in these squares. It is believed that this is the first time stars have permanently

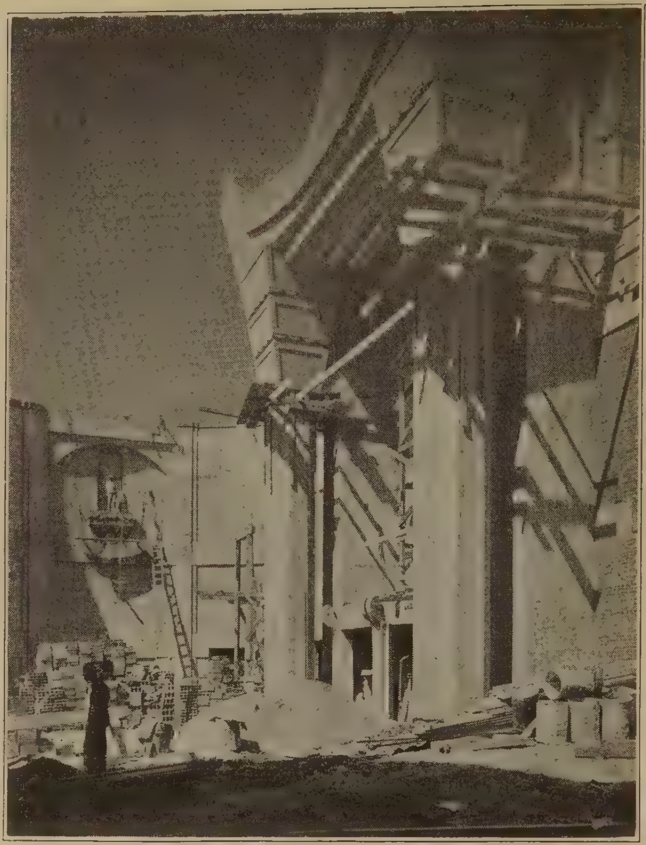


Concrete is the dominant construction material used in this outstanding movie theater. It is reinforced concrete for the structural frame, art stone for decorations and colored portland cement stucco for wall surfaces imprinted their well wishes in the building materials of any moving picture theatre.

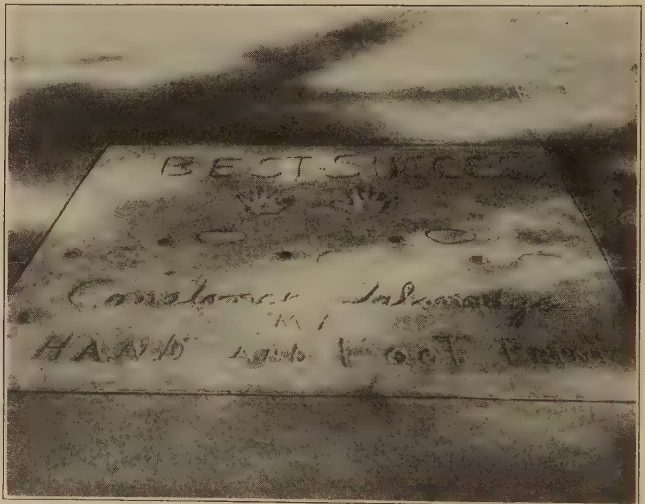
For the embellishment of the front facade and the court a concrete art stone manufactured locally was selected. The principal material used was portland cement stucco covering all the walls of the interior and exterior. This material was worked out in a myriad of colors and tints typical of a period in Chinese architecture when color and magnificence were the ruling passion.

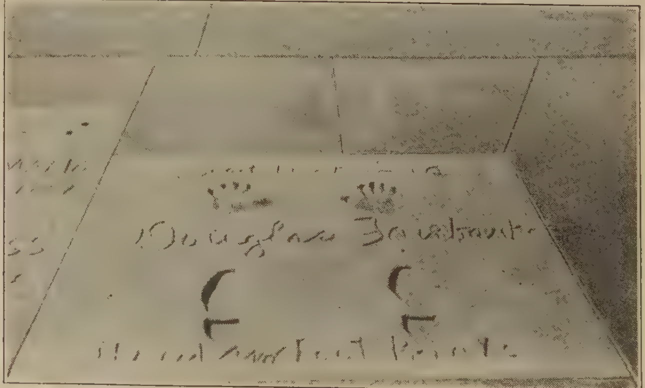
Colored Concrete

Due to the architectural design of the theatre a departure from customary architectural procedure was followed in that decoration has been given a paramount position to the architectural work. The most important feature of such a procedure has been to secure a color symphony for the entire theatre, based entirely upon the one dominating color of Chinese architecture—red. Numerous shades and tones of this one color are seen throughout the structure. The initial use of the basic red is in the Genius statue over the main entrance. The two flanking columns pick up the color and redouble it in the four red lacquer columns of the lobby. The ceilings of the foyer carry shades of coral and red and gold reach their crescendo in the main auditorium ceiling. All the seats and carpetings are in harmony with this style of architecture and coloring.



An example of the extensive uses of structural concrete showing the intricate formwork involved





Permanent records of well wishers were imprinted in the soft concrete by the famous of movie land

Organizations

American Concrete Institute; Harvey Whipple, Secretary, 2970 West Grand Blvd., Detroit.

American Concrete Pipe Association; M. W. Loving, Secretary, 33 W. Grand Ave., Chicago.

American Construction Council; Dwight L. Hoopingarner, Executive, 28 W. 44th St., New York City.

American Engineering Standards Committee; Dr. P. G. Agnew, Secretary, 29 West Thirty-ninth St., New York City.

American Road Builders' Association; Chas. M. Babcock, President; Miss E. A. Birchland, Secretary, 29 W. 39th St., New York City.

American Society of Civil Engineers; Geo. T. Seabury, Secretary, 33 W. 39th St., New York City.

American Society for Testing Materials; C. L. Warwick, Secretary-Treasurer, Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa.

Associated General Contractors of America; D. H. Sawyer Secretary, 1150 Munsey Bldg., Washington, D. C.

Associated Metal Lath Manufacturers; 123 West Madison St., Chicago; Wharton Clay, Commissioner.

Building Officials Conference of America; H. E. Plummer, President; Fred W. Lumis, City Hall, Springfield, Mass., Secretary.

Concrete Reinforcing Steel Institute; M. A. Beeman, Secretary, Tribune Tower, Chicago.

Concrete Products Association; S. I. Crew, President, Norwood, Ohio; Austin Crabbs, Secretary, Box 343, Davenport, Iowa.

Iowa Concrete Products Association; Floyd Goodrich, President; R. L. Gavin, Secretary-Treasurer, 405 Hubbell Bldg., Des Moines, Iowa.

National Association of Building Trades Employers; A. E. Coleman, President; A. W. Dickson, Executive Secretary. 2226 Builders Building, Chicago, Illinois.

National Association of Builders' Exchanges; William F. Chew, Baltimore, President; Earl F. Stokes, Secretary, 15 East Fayette St., Baltimore, Md.

National Crushed Stone Association; J. R. Boyd, Secretary, 751 Earle Building, Washington, D. C.

National Housing Association; Lawrence Veiller, Secretary and Director, 105 East Twenty-second St., New York City.

The National Lime Association; G. B. Arthur, Secretary, 927 15th Street, N. W., Washington, D. C.

National Slag Association; H. J. Love, Secretary-Treasurer, 933 Leader-News Building, Cleveland, Ohio.

National Sand and Gravel Association; V. P. Ahearn, Executive Secretary, 432 Munsey Bldg., Washington, D. C.

Nebraska Concrete Products Association; A. V. Anderson, President, Reimers-Kaufman Co., Lincoln, Neb.; E. L. Bateman, Secretary, Bethany, Neb.

Ohio Concrete Products Association; G. M. Friel, Secretary-Treasurer, 2284 North High St., Columbus, Ohio.

Portland Cement Association; William M. Kinney, General Manager, 33 West Grand Ave., Chicago.

Rail Steel Bar Association; H. P. Bigler, Engineering Secretary, Builders' Bldg., 228 N. La Salle St., Chicago, Ill.

Wisconsin Concrete Products Association; A. P. Kuranz. Secretary-Treasurer, 425 E. Water St., Milwaukee.

Mixer Musings

Reported by "Joe"—The Mixer Boss.

First Annual Report of the Guild of Certified Slump Testers

To All C. T. S.'s, Greetings!

KNOW all ye who have attained to the high and honored degree of Certified Slump Testers that your humble servant, Joe, the Mixer Boss, Keeper of the Records, has gone in silent, serious conference with himself for the purpose of reviewing the progress made by the Honorable Order during the past year and (if the glance does not blind him) to hazard a look into the future.

In reviewing the work of the Slump Tester, it is not enough merely to glance through the records of membership, though even such a review would reveal the names of the Great in the concrete industry. Nay, it would be more appropriate rather to glance at the progress made in the entire industry, for are not the Slump Testers those who guide its destinies?

On other pages in this journal will be found accounts of what can rightfully be considered the work of the Guild. Study them and rejoice!

But let us, learned brothers, consider our own affairs for a minute, even though this is contrary to the highest aims of our noble band. What lies before us? Do not all the signs point to the fact that 1928 is going to be the greatest year ever in the making of quality concrete? And can this work go on without the co-operation of the Guild? The answers are obvious.

Now, therefore, it behooves every true and loyal member to rally to the standard. Let every Certified Slump Tester always Test and never Slump—that is to say, let him persuade, coerce, influence, bribe, force, or in any other way secure more members for the Guild so that work may go on as it should.

It is difficult to make a financial report for the simple reason that there are no finances, even though there are financial problems aplenty.

So we come to the end of the first year of the existence of the Guild of Certified Slump Testers.

Submitted in a sorrowful but hopeful mood,

Joe, the Mixer Boss,
Keeper of the Records.

Joe:

I, ______________, hereby express my interest in your wonderful organization and request you to send me additional interesting facts regarding the Guild of Certified Slump Testers and of the unique advantages that members enjoy.

It is understood that I do not obligate myself in any manner by simply asking for information.

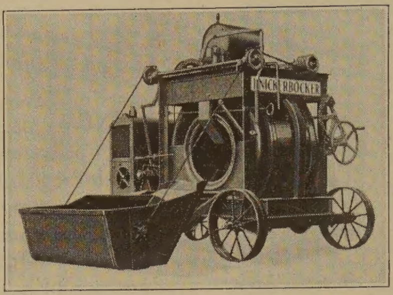
Address JOE, THE MIXER BOSS,
139 No. Clark St., Chicago.

New Equipment and Materials

1928 Knickerbocker Mixer Features Higher Drum

A number of changes in design are found on the new Knickerbocker mixers, manufactured by the Knickerbocker Company, Jackson, Michigan. The drums are higher and shorter. A water measuring tank of an entirely new design gives accurate water measurement.

From the loading side near the engine the control levers have been brought around to the drum end of the mixer. Once the engine is started the operator remains at the discharge side while putting it through its functions. Thus the barrows and buggies are uniformly filled and charging and discharging time is lowered.



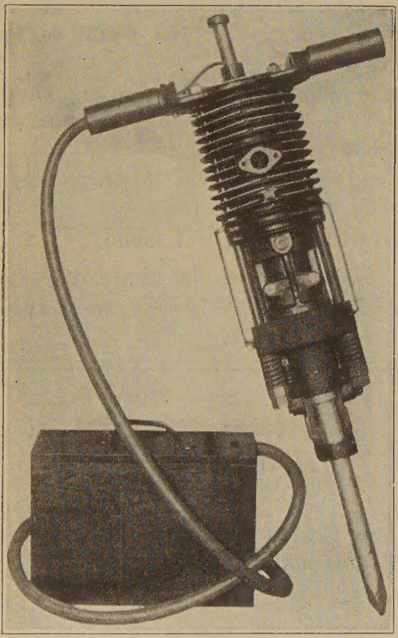
Shown in the illustration is a 10-S and other sizes are similar in design. Larger mixers have added characteristics required for mixers of their capacities.

Concrete Pavement Breaker Enters Market

A pavement breaker, gasoline-powered and without fly wheel, connecting rods, cam shaft or bearings, has been perfected and is now being promoted by the Milwaukee Gas Tool Corporation, Milwaukee, Wisconsin. The machine is named Rodax.

The piston operates as the hammer, striking more than 1,000 blows per minute. These blows are transmitted through an anvil direct to any standard cutting tool which may be used.

The entire unit weighs but 85 pounds and will operate all day on two gallons of gasoline. It requires no outside equipment to operate it. It is a self-contained unit.



Rodax will be on display at the Good Roads Show to be held in Cleveland.

New Novo Rollr Engines for 1928

A new single, a new two, and two new ofurs, will be added to the line of Novo Rollr industrial engines in 1928.

At present, there are three sizes of two-cylinder Novo Rollr engines: 6, 9, and 12 h.p. These are available in either hopper- or radiator-cooled types.

A Novo two-cylinder Rollr engine of another size will be offered in January. This will be an 8-h.p. unit, being designated as Model HU. It has a 3-3/16-inch bore and 4-inch stroke. The line of two-cylinder Novo Rollr engines will then be as follows:

Fu—3 x 4 inches	6 h.p.
Hu—3 3/16 x 4 inches	3 h.p.
RU—3½ x 5 inches	10 h.p.
YU—3¾ x 5 inches	12 h.p.

The two new single-cylinder Novo Rollr engines will be, in appearance, similar to the well-known line of two-cylinder engines. It is planned to manufacture two sizes:

3 x 4—1½	3 h.p.
3-3/16 x 4—2	4 h.p.

At the same time, Novo will also bring out two new four-cylinder engines. These will also be known as Rollr engines. In fact, they are "double-up" two's. The two sizes are as follows:

FFU—3 x 4 inches	12 h.p.
HHU—3-3/16 x 4 inches	16 h.p.

These new Rollr engines incorporate advanced practices such as are found in no other four-cylinder power units. At the same time these developments are practical, since they have been in general use on all Novo two-cylinder Rollr engines for two years. Briefly, the features of these new engines are as follows:

1. Timken roller bearing on crankshaft and power drive shafts add new smoothness, more horsepower and longer life, and provide positive alignment always.
2. The "double" 180-degree throw crankshaft eliminates vibration.
3. Novo Rollr engines start easily and safely always. The automatic impulse on the magneto gives a hot spark at any cranking speed. No "kick-backs" possible.

Heltzel Makes Heavy Road Form; Setting Is Simple

According to an announcement made by the Heltzel Steel Form and Iron Co., Warren, Ohio, the design of its road rail is unchanged. It is made of 3/16-inch special steel plate with double reinforcing flanges and a 6-inch base.

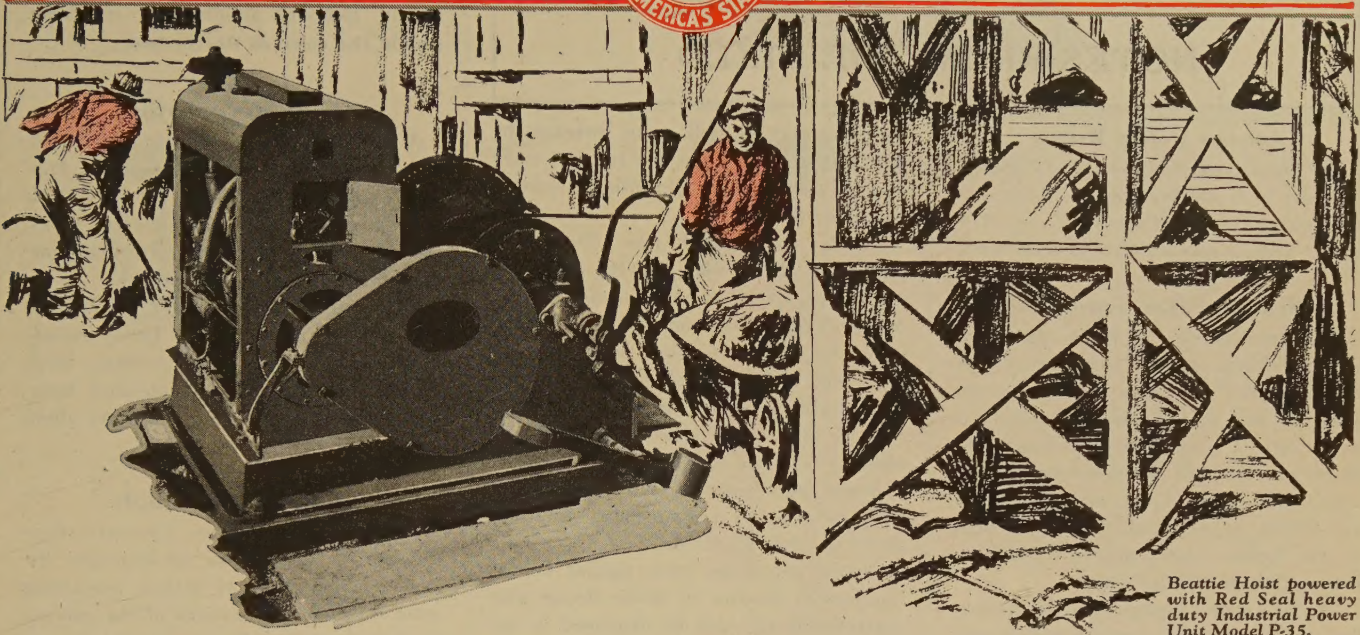
Massive steel stake pockets are welded to the two rail flanges. Giant 1-inch round steel stakes are used with an angular shaped steel joint lock made of ¼-inch steel plate. This stake lock wedges between the stakes and the face of the rail with one leg of the lock wedging against the intersection of the face and top of the rail and the other leg wedged against the intersection of the face and base of the rail.

Two wedge shaped swells pressed into the stake lock wedge, one against each stake, making an absolutely positive locking arrangement, and a larger swell pressed into the stake lock serve as a releasing lug which when tapped with a sledge, unlocks the form.

To set the form, the rails are butted end to end, the joint lock placed in position and the stakes driven. A tap with the sledge locks the forms and aligns the rails.

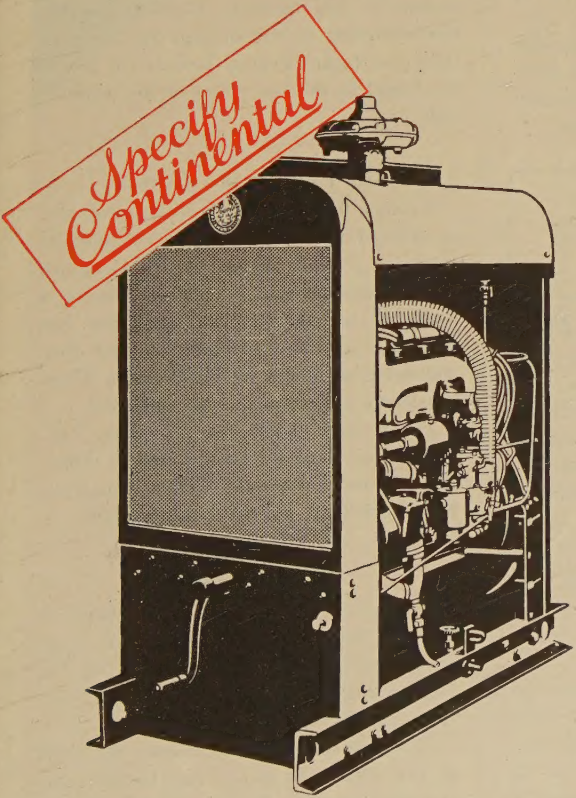
Dependable Power for Every Purpose

CONTINENTAL MOTORS ★ AMERICA'S STANDARD ★ Powerful as the Nation



Beattie Hoist powered with Red Seal heavy duty Industrial Power Unit Model P-35.

A Rugged Quality of Endurance



The rugged quality of endurance so paramount in every Heavy Duty Red Seal Continental motor insures long life and economy to users.

Continental design and construction, based upon nearly three decades of specialization in gasoline motor building, are powerful factors in maintaining Continental leadership in the field of industrial power.

CONTINENTAL MOTORS CORPORATION
INDUSTRIAL EQUIPMENT DIVISION
Office and Factory: Muskegon, Michigan

The Largest Exclusive Motor Manufacturer in the World

Continental Motors

About Makers of Equipment and Materials

NOTES FROM THE FIELD

Chicago Celite Moves

The Chicago office of the *Celite Products Company* in November removed to its own building at 225 East Superior Street. The former address was 53 West Jackson Blvd.

Red Seal Developments

New developments in heavy duty *Red Seal* industrial engines and power units known as the "A" series, several new engines as well as the complete industrial series with a power range of from 5 to 96 horsepower will be displayed by the *Continental Motors Corp.*, in booths EH93 and EH105, at the Road Show, to be held in the Public Auditorium at Cleveland, January 9th to 13th inclusive.

The "A" series consists of a transformation of several of the present well known Continental industrial power units, changing the entire housing to lesser dimensions, for the purpose of making them more compact as well as to increase the potential market. Many new features made possible through these dimensional changes have been added.

Among the several new Continental industrial power units to be added to round out the Continental series is the Model P-52. This consists of a heavy duty four cylinder vertical head type engine with a five inch bore and six inch stroke, making it the largest of the Continental fours. The total piston displacement is 471.2 cu. in. total for four. It is a slower engine capable of developing 52.5 horsepower as its recommended governed speed of 1100 R. P. M.

Several departures from regular known Continental practice in motor design and construction will also be displayed in the form of a six cylinder overhead valve series. These are built exclusively to serve both the commercial and industrial fields.

Several display boards will be utilized to acquaint those attending the show with the various and major parts that make up the Continental motor.

Numerous Continental powered installations covering practically the entire diversified industrial field will be on display and performing throughout the show.

NEW EQUIPMENT

(*Continued*)

New Crawfordsville English Roof Tile Machine

The Crawfordsville Machinery Company, Indianapolis, Indiana, is now manufacturing machines for making English concrete roof. This is a flat tile, especially desirable for the English type house. It may be made in a broad variety of colors and finished with either a rough or smooth top-coat.

Like those for other tile, the pallets and molds are covered with patented non-slip cleats, which hold the concrete in place as it is tamped and troweled.

New M & M Timber Shore Is Announced

The new M & M timber shore can be set up with a rock, upside down, under a working load of 4,000 pounds, by one man.

This shore is made by the M & M Wire Clamp Company, Minneapolis, Minn.

A load may be raised or lowered by driving a wedge with a hammer, eliminating all special tools. The shore secures positive adjustment, with locking at any height, without settling. The weight of the shore is 36 pounds. Random length 4 by 4's may be used.

INDUSTRIAL LITERATURE

Hoists, Mixers, Saw Rigs, Etc.

The C. H. & E. Manufacturing Company, Milwaukee, Wisconsin, has completed publication of an 18- by 24-inch broadside with rotogravure illustrations. Ten detail illustrations show reversible hoists, mortar mixers, material elevators, single acting hoists, and saw rigs in use on jobs. An entire page is devoted to four different units and their respective positions on a warehouse job.

Stuccoed Buildings

The California Stucco Products Company, Los Angeles, California, and Pittsburgh, Pennsylvania, has issued No. 2 of Volume 1 of *"California Stucco,"* a 32-page publication. Illustrated are exteriors of numerous structures, including tall apartments, studios, libraries, wholesale houses, and residences that are finished with California stucco.

The structures vary widely in type, height, location, architectural treatment, and in the color of stucco used.

On Waterproofing

A circular, *"About Concrete and Permanence,"* has been received from the *Minwax Company*, New York City. It deals with a subject of prime interest today, viz., the action of frost, corrosion, crazing, and water upon permanence.

Specifications are given for the application of *Minwax* products. These include transparent, surface waterproofings, brick and cement coating, dampproofing materials, clear waterproofing, and other allied products.

Hume Pipe Book

The American Hume Concrete Pipe Company is distributing an elaborate, 24-page booklet, 9 by 11 inches, containing some excellent illustrations of the process of manufacturing Hume reinforced concrete pipe. Each step, from the welding of the reinforcing to the placing, is pictured.

Pressure and crushing tests have been made of the pipe and the results are shown in this booklet. Physical properties according to size of pipe are given in tabulated form. Typical layouts for plants are found in the last pages of the publication.

On Ferrocrete Roads

Number 9 of the *"Ferrocrete Bulletin"* is devoted for the most part to concrete roads, in general, and at specific locations. A few facts accompany photographs of a dozen or so pavements. Among the last few pages are found descriptions and illustrations of a number of buildings in whose construction Ferrocrete was employed.

The Cement Marketing Company, Ltd., of London, England, represented in America by the *Ferrocrete Import Company*, New York City, publishes the bulletin.

Celite Leaflet

"Designing Concrete for Workability as Well as Strength" is the title and scope of a four-page leaflet published by the *Celite Products Company*, New York, Chicago, and Los Angeles.

Slump tests well pictured show the effect of the admixture in concrete in the cohesiveness secured. The booklet deals with the subjects of workability versus consistency, and the relation of consistency to strength. Also included is an illustration and curve of a penetration test. Following these are directions for using Celite.